Tampere University

Aleksi Kesseli

LUDOLOGICAL LEARNING: PRESENTING AN EVALUATION FRAMEWORK FOR ANALYSIS, DESIGN AND IMPROVEMENT OF GAMIFICATION OF EDUCATION

Faculty of Information Technology and Communication Sciences (ITC)
Master's thesis
10/2020

ABSTRACT

Aleksi Kesseli: Ludological learning: Presenting an evaluation framework for analysis, design and improvement of gamification of education
Master's Thesis
Tampere University
Internet and Game Studies
October 2020

Gamification is a growing field that seeks to harness the motivational power of video games by applying game elements to non-game contexts such as education and fitness. This thesis seeks to find how gamification of education could be expanded or improved upon in the future through analysis of 10 contemporary gamified educational programs. A new evaluation framework based on motivational affordances of game elements is used in this process.

The evaluation framework presented in the thesis links motivational theories such as self-determination theory to game elements used in gamification. The framework provides a potential tool to guide and help designers and educators in the gamification process. The results of the analysis highlight underrepresented elements and potential areas of improvement in gamification design. Suggestions for ways to improve gamification of education are presented in the end.

Keywords: gamification, education, game design, motivation, self-development theory, flow theory

TABLE OF CONTENTS

1 INTRODUCTION

> "Sometimes stories about games make their way into the media. Around the year 2000 they were usually about how games turn mild-mannered suburban kids into desensitized high school-shooters. But things have changed. Warnings about aggressive emotions, caricatured gender images, and detrimental effects of time spent in front of a screen now compete with claims about gamification as a magic key to business success and utopist visions of a better game-based tomorrow for education, citizenship and science participation." (Lieberoth, Wellnitz & Aagaard, 2015, 175).

The public perception of video games has developed and changed during the last 20 years as their effects and benefits have become more researched. Players can voluntarily spend hours working their way through hard and challenging games, but such motivation is rarely seen in the classroom (Guyne, 2007; Dicheva et al., 2015, 1). As motivation is the most important factor that drives learning, educators have started using video games to study how to create and sustain motivation (Gee, 2003, 3; Dicheva et al., 2015, 1-2). Utilitarian use of games has a long history dating back to 475 BC China (Deterding, 2014, 27), but the phenomenon has truly gained traction during the last decade with the emergence of gamification (Koivisto, 2017, 24-25). Gamification is design that seeks to induce a game-like experience in a non-game context, such as a classroom (Huotari & Hamari, 2017, 25; Koivisto, 2017, 17).

The ubiquity of video games in the lives of younger generations has shaped how they learn and process information, which is something that educators have to adapt to (Simpson, 2005, 477; Jenkins, 2005, 48). Technological development is another explanation for the growing popularity of gamification, as modern digital technology enables more detailed tracking and measuring of user behavior (Koivisto, 2017, 25). Tracking students' progress is essential to achieving learning objectives in education (Kiryakova, Angelova & Yordanova, 2014, 2), so the wide variety of performance data video games provide can make them useful for education (Griffiths, 2002, 47). Providing more feedback isn't the only purported benefit video games pose over traditional class-room learning (Kapp, 2012, 35), as they teach information in a context which provides a more clear rationale for learning (Jenkins, 2005, 50), making it more likely to be retained (Gee, 2003, 2). Games also allow the simulation of concepts and events that cannot be demonstrated in the real world (Nah et al., 2013, 104) and allow for repeated failure and learning from mistakes, so gamification has the advantage of reframing failure as a necessary part of learning (Lee & Hammer, 2011, 3-4).

While the growing amount of research data on the benefits of video games looks alluring to educators, there are many unanswered questions surrounding the use and efficacy of gamification (Koivisto, 2017, 18). This thesis provides an overview of what current research says about gamification of education. Based on said research, it presents a new evaluation framework for identifying game elements, as gamification of education is based on application of game elements (Pechenkina et al., 2017, 2) according to prevailing definitions (Huotari & Hamari, 2017, 26). The framework is demonstrated in a case study of 10 gamified applications, which identifies and analyses the game elements used in contemporary gamification design. This thesis seeks to answer the research question of "how could gamification of education be expanded or improved in the future?" from this perspective of game elements.

2 BACKGROUND

In this chapter, I explain the background of my research and gamification of education.

2.1. Background and research question

I am an Internet and Game Studies major from the University of Tampere in Finland. I have a background in accounting, game journalism, game design and gamification. My interests within the field of ludology include gamification, transgressive play, emergent gameplay and game history. Although I have a professional interest in gamification, the topic of my thesis was influenced by a job opportunity at Educational Alliance Finland. Education Alliance Finland provides evaluation services to learning solutions and products, specializing in gamified education software. I was commissioned by the company to develop an extension to the heuristic framework used in their evaluation process. I was given a list of research articles and educational games to aid me in this project, but no restrictions or objectives were placed on my research and I was free to choose what resources to include in my work. The contract I signed with Education Alliance Finland dictates that I will receive the first part of my fee after finishing the framework and second half after finishing my thesis.

Due to this obligation to develop the framework, my thesis is structured around it. In the first part of the thesis, I conduct a literature review on gamification of education and its design. In the second part I use this theory to formulate the framework. In the third part I demonstrate the framework in action by using it in a case study of gamified applications, using formal analysis as my method. In the final part I address the results and implications of this analysis and how they relate to issues raised in the literature review. Ultimately my research question is “How could gamification of education be expanded or improved in the future?”. The framework is used as a tool to answer this question from the perspective of game elements.

2.2. Gamification

2.2.1. Definition

Gamification is used to engage people, motivate action, promote learning and solve problems (Kapp, 2012, 74). It has been applied and researched in many different contexts, including sustainability, health and wellness and education, with research and education being among the most popular application according to a survey by Seaborn & Fels (2015, 27). There is no consensus about the specific definition of the term gamification and its scope, but the most widespread definition of gamification comes from Deterding et al. from 2011 (Mora et al., 2017, 526), which I will use in this thesis. According to Deterding et al. (2011, 13), "gamification" refers to:

- *the use* (rather than the extension) *of*
- *design* (rather than game-based technology or other game related practices)
- *elements* (rather than full-fledged games)
- *characteristic for games* (rather than play or playfulness)
- *in non-game contexts* (regardless of specific usage intentions, contexts, or media of implementation).

Design limits gamification only to game design, not the use of game-based technologies or practices, such as game controllers. Game design elements exist on five varying levels of abstraction, which are all included in that definition. These are interface design patterns, game design patterns/game mechanics, design principles/heuristics, conceptual models of game design units and game design methods and design processes. (Deterding et al., 2011, 12).

Defining the meaning of a game element is complicated according to Deterding et al. (2011, 11-12), as many game elements would be hard to identify as gameful or game-specific if removed from their context. For that reason, Deterding et al. (2011, 11-12) definition restricts gamification to elements that are "characteristic to games", meaning game elements that "are found in most games, readily associated with games and found to play a significant role in gameplay". Seaborn & Fels (2015, 17) later refined game elements as patterns, objects, principles, models, and methods directly inspired by games.

Deterding et al. (2011) suggest use of the term "gamefulness", introduced by McGonical (2011, as cited by Deterding et al., 2011, 11) to provide a meaningful ground for defining gamification. Gamefulness denotes the qualities of gaming (ludus), and thus gameful design is designing for gamefulness, typically by using game design elements (Deterding

et al., 2011, 11). In game studies, Caillois' (1961/2001) dichotomy of paidia and ludus are often utilized to distinguish playful activities and games into two distinct categories. Ludus ("gaming") denotes games structured by rules, based on competition and striving towards a goal, whilst paidia ("playing") denotes expressive and improvisational freeform play. (Caillois, 1961/2001)

As there are many different contexts for gamification, the only context that is explicitly intended to be excluded from the definition is the use of game design elements as a part of designing a game, as "that would simply be game design, not gamification" (Deterding et al., 2011, 12). Gamification is distinguished from full-fledged games in the fact that it does not fulfill the definition of a game; a game can be educational or have pragmatic uses though in the case of serious games, which are games designed with such an intent, rather than systems that incorporate some game elements (Deterding et al., 2011, 12-13). Koivisto (2017, 29-30) perceives this use of game elements and non-game contexts in this definition as problematic due to their conceptual vagueness and normative stance on what constitutes a normal context for game-like interactions. Huotari & Hamari (2017, 25) also argue that due to the subjective nature of games and gameful experiences, it is hard to identify a non-game context.

Gamification is distinguished from regular entertainment games in the fact that it does not fulfill the definition of a game. A game can be educational or have pragmatic uses though in the case of serious games, which are games designed with such an intent, rather than systems that incorporate some game elements. (Deterding et al., 2011, 4). In this thesis, I will use the term "educational game(s)" to refer to educational software products which fit Deterding et al. (2011) definition of gamification. Although they are not full-fledged games, for the sake of simplicity it is easier to refer to these products as games. I define educational software/game in this context as any application that is designed with the intent of teaching the user a specific skill, regardless of whether they are designed to be used in class-room education or not.

2.2.2. Gamification of education

Gamification in education can be broadly understood as the use of game elements in non-game contexts, purposed with increasing student engagement and motivation (Pechenkina et al., 2017, 2). Whitton (2009, 41) sees digital games ability to create engagement as one of their important features in the context of learning. Engagement is generally seen as a key component of learning environments (Paulus, Horvitz & Shi, 2006, 355), and without it, activity remains uninteresting, which prohibits learning (Balzer, 2011, 35-36; Harvianen & Meriläinen, 2019, 554). Engagement usually means fun (Whitton, 2009, 41; Harviainen & Meriläinen, 2019, 557).

Various studies have reported significant correlations between introducing gamified elements into the learning process and increased student motivations (Pechenkina et al., 2017, 3). In a review of more than 70 empirical research studies on the use of digital games in the classroom, the most observed positive outcomes were affectivity, motivation and learning (Connolly et al., 2012). One study investigating the use of a gamified mobile learning app to boost engagement of university students saw a boost of 7.03% higher grades and an increased retention of 5.37% - 12.23% when comparing students who used the app to those who did not. (Pechenkina et al., 2017, 2-6).

A meta-analysis on serious games found them to be more effective in terms of learning and retention, but did not notice any effect on motivation when comparing to conventional instruction methods (Wouters et al., 2013, 1). A literature review conducted by Hamari, Koivisto & Sarsa (2014) on 24 empirical studies on gamification found that in an education/learning context, all studies considered the learning outcomes of gamification as mostly positive. Some caveats exist though, such as increased competition, task evaluation difficulties and novelty factor skewing results of short-term research. (Hamari et al., 2014, 4-6).

How well gamification works is context and user dependent according to Hamari et al., (2014, 6), as some contexts such as e-commerce sites might prove to be challenging to gamify, and user attitudes towards gamified systems and elements such as competition vary. Harviainen & Meriläinen (2019, 558) also highlighted the context specific nature of applying gamification to education, stating that instead of seeking to conclude whether the method works categorically or not, the focus should be on leveraging its strengths and avoiding its weaknesses and evaluating its suitability for the given context. Digital games

should not be used for education based solely on the assumption that they are motivational according to Whitton (2009, 41), who posits that the rationale for using games should be that they embody sound educational principles and are an effective way to learn within the particular context they are used in. Whitton (2009, 41) argues that just because an educational tool is a game, it shouldn't be the sole motivation to use it. Especially in the case of older students, it is crucial that students are aware of the educational benefits of the game and perceive it as having value to their learning (Whitton, 2009, 41; Kapp, 2012, 102).

Whitton (2009, 41) posits that the real educational value of games doesn't lie in their motivational benefits, but in the sound educational principles that many embody. For example, motivating games are exceptionally good at prompting out-of-game information seeking and learning according to Harviainen, Lainema & Saariainen (2014, 63). Players can also unintentionally learn skills such as group management and social skills in commercial games (Duchenaut & Moore, 2005, 97-99; Harviainen et al., 2014, 63). Adapting from Gagné et al. (1992), Whitton (2009, 65-66) identifies five categories of digital game-based learning. These are intellectual skill (understanding concepts, rules and relationships, such as in the context of using algebra to solve a puzzle), cognitive strategy (developing techniques and models of problem-solving and action), verbal information (relating facts such as scientific terminology), motor skills (improving actions that use muscles, such as dancing) and attitude (developing new beliefs and feelings, such as affinity for reading). Kapp (2012, 190-192) also identifies different learning domains such as declarative knowledge, procedural knowledge and soft skills, providing different gamification approaches for each domain.

There are differences between conceptual categories such as games, gamified applications, serious games and simulations (Deterding et al., 2011, 11), so not all of the benefits and characteristics of entertainment games can be extrapolated to apply in the context of gamification. For example, results from research on training simulations and games do not necessarily apply to educational games and educational use of commercial games (Harviainen et al., 2014, 63). There are fundamental differences between educational and commercial/entertainment games, for example time is often a very limited resource in education (Whitton, 2009, 124). This means that in an educational context, designers seek to minimize the time players have to spend learning to play the game, whereas in commercial games the process of learning to play the game is often a

key part of the game and its fun (Whitton, 2009, 122-123). Commercial games also tend to have much larger budgets and better production values (Whitton, 2009, 63).

Educational gamification should seek to balance fun or engagement with reflection, provide a smooth learning curve that progressively grows as the player learns new skills and gains knowledge and leave room for experimentation according to Harviainen & Meriläinen (2019, 557-558). The authors posit that much of the current theory on gamification of educational context relies on conjecture and extrapolation, meaning that "we have great examples of it working, but know little of why it actually works" (Harviainen & Meriläinen, 2019, 553-554). Seaborn & Fels (2015, 29) suggest that more empirical, mixed methods research is necessary to substantiate the initial positive effects reported. The sentiment was echoed by Bozkurt & Durak (2018, 30), who posit that gamification should be explored within different research paradigms.

2.2.3. Criticism

Toda, Valle & Isotani (2017) identified four negative effects with gamification of education across 17 studies. Loss of performance was the most reported issue, arising from gamification hindering students' learning process. The second most cited issue was undesired behavior, when the gamification lead to an unpredictable outcome. It was followed by indifference, when gamification did not influence the outcome in either direction. Finally, declining effects were reported in five studies, where motivation and engagement declined gradually. (Toda et al., 2017, 151-153). Sugarcoating an educational purpose with a game and making it mandatory has been called the "chocolate covered broccoli" -effect (Lee & Hammer, 2011, 4; Harviainen & Meriläinen 2019, 553-554), which carries the risk of reduced engagement with the activity after the novelty of gamification wears off (Koivisto & Hamari, 2014, 181). Hung (2017, 60-61) also raised concern over the use of learning analytics in the application of gamification of education, as equating superficial measures such as clicks and file downloads with student engagement might not correspond to actual learning.

Environments such as educational institutions and workplaces are often built around competition, goals and rewards according to Harviainen & Meriläinen (2019, 557), who advise designers to pay attention not to turn gamification into a cosmetic makeover of these environments. Whitton (2009, 124) points out that competition between players can lead students to focus on winning the game at all costs rather than learning from it, which

can detract from the intended learning objectives. This can lead players to experiment less and avoid taking risks, sticking to perceived winning strategies, even if the strategies would be absurd in real life (Harviainen et al., 2014, 67). Individual competition can also make players to be unwilling to share what they've learned to avoid the risk of losing their competitive edge (Harviainen et al., 2014, 68-69).

Beyond technical implementation, Gamification has been criticized as a term/concept (Hung, 2017, 60). Academics and game designers, such as Ian Bogost (2011) and Margaret Robertson (2010), have criticized it on the grounds that it simplifies the game medium by representing the elements least essential to games as the core of the experience (Deterding et al., 2011, 11; Hung, 2017, 60). Bogost (2015, 71) even calls gamification a form of colonization. Nicholson (2012, 1) states that "gamification typically uses only the least interesting part of a game - the scoring system". This prevalent approach to gamification that exclusively relies on point-based game elements, such as points, badges and leaderboards has been referred to as pointsification (Marczewski, 2013 as cited by Kifetew et al., 2017, 322; Hung, 2017, 60). Gamification is context-dependent, so inserting game elements such points, badges and leaderboards with-out proper design will not ensure positive desired outcomes (Toda et al., 2017, 144). Superficial addition of points, rewards and badges to learning experiences isn't gamification according to Kapp (2012, 74).

Academic and industry critiques of gamified applications have emphasized that they focus almost exclusively on design elements for rule-bound, goal-oriented play (ludus), ignoring paidia (Deterding et al., 2011, 11). Harviainen & Meriläinen (2019, 557-558) suggest that a more playful approach of gamification that emphasizes fun, creativity and collaboration over tasks, rewards and competition could help overcome some of gamifications challenges and criticisms. Seaborn & Fels (2015, 18) note that scholars and practitioners in and outside of gamification sphere have used the term gameful design to reference gamification, but it is not universally agreed upon, as Lee & Doh (2012) consider gamification and gameful design to be separate entities at odds with each other. According to Lee & Doh (2012, 34-35) gamification focuses on extrinsic motivation while gameful design focuses on intrinsic motivation.

Hung (2017, 1) states that gamification is controversial for having the tendency to rely on extrinsic motivation. Extrinsic motivation describes an activity that is motivated by an external pressure or reward. It thus contrasts with intrinsic motivation, which refers to

participating in an activity simply for the enjoyment of the activity itself, rather than its instrumental value. (Ryan & Deci, 2000a, 56-60). Extrinsic motivation has been shown to produce negative effects, such as decreased intrinsic motivation (Deci, Koestner & Ryan, 2001, 15; Seaborn & Fels, 2015, 19). However external rewards only threaten intrinsic motivation for activities that people find interesting (Deci, Koestner & Ryan, 1999, 650; Mekler et al., 2013, 72). Extrinsic motivation is most likely to affect intrinsic motivation negatively if the reward is functionally superfluous and uninformative in relation to the task according to Kapp (2012, 103). The findings of Mekler et al. (2013) suggest that game elements considered to be extrinsic incentives (points, levels and leaderboards) do not affect intrinsic motivation and are viable means to promote specific user behavior in non-game contexts (Mekler et al., 2013, 67). An extrinsic reward such as points can have intrinsic value if it provides feedback to the player, and can help learners partake in tasks that initially do not seem to provide much value (Kapp, 2012, 103).

The survey of Seaborn & Fels (2015, 28) on gamification concluded that the "present body of applied gamification research suggests that success might be improved across the board if the design of gamified systems – especially extrinsic motivators – is informed by end-users' intrinsic motivators". Sakamoto, Nakajima & Alexandrova (2012, 421-422) wrote that gamification frameworks at the time did not take into account how to increase user's intrinsic motivation. The same year Nicholson (2012, 5-6) proposed a framework for "meaningful gamification" based on intrinsic motivation in opposition to "meaningless gamification", which he defines as gamification tactics that rely upon external rewards such as points and levels. His work utilizes organismic integration theory (a sub-theory of self-determination theory), situated motivational affordance and universal design for learning, using user-centered design to link these theories together (Nicholson, 2012, 2-5). Findings of Seaborn & Fels (2015, 28) also suggest that "user-centred design methodology may help elucidate intrinsic motivators for a given user population". Instead of focusing only on motivation, further research is needed to investigate the impact that gamification has on the user experience according to Mora et al. (2017, 538). In the next chapter, I will showcase literature on the issue of user-centered design, how to apply gamification and address some its criticisms.

3 LITERATURE REVIEW

In this chapter, I will showcase different potential frameworks to utilize in gamification. Mora et al. (2017) conducted a systematic review of 27 gamification design frameworks to survey the field. User-centered design principles were explicitly featured in most of the frameworks (Mora et al., 2017, 525). All but one of the frameworks considered fun a relevant issue for the design process. Motivational theories were also at the core of the design process in all of the frameworks, with self-determination theory (SDT) by Ryan & Deci (2000) being the predominant source. (Mora et al., 2017, 537). I will first review literature on user-centered design and fun, then move on to motivational theories and SDT, after which other potential frameworks will be reviewed.

3.1. User-centered design and experience design

User-centered design was prevalent amongst surveyed gamification frameworks by Mora et al. (2017) and its use was suggested both by Seaborn & Fels (2015) and Nicholson (2012). Whitton (2009, 151) considers user-centered iterative design the ideal development process for creating games for learning. Most of the frameworks reviewed by Mora et al. (2017, 525) also highlighted iterative process as the main design principle. But what is user-centered design? And how does it relate to research of fun?

The term “user-centered design” (UCD) and “user experience design” (UX) are often used interchangeably. There’s a distinction though, as UX is the discipline, while UCD is a process. (Benyon, 2010, 97; Bowles, 2013). UCD is the dominant design approach within UX according to product designer Cennydd Bowles (2013). UCD is a broad term used to describe design in which end-users influence how a design takes shape. The way in which users are involved varies, but their involvement stays central to the method. (Abras, Maloney-Krichmar & Preece, 2004, 445). The user’s needs and goals are the primary consideration. During every decision in the gamification process, the user-centered designer must ask: "How does this benefit the user?”, Nicholson (2012, 5) states.

The PLEX (Playful Experience) framework based on playful UX (Korhonen, Montola & Arrasvuori, 2009, 274) could provide an UCD-oriented way of addressing some of the criticisms raised against gamification mentioned in the previous chapter. While stating that gamification has a tendency to ignore playfulness and focus on rule-bound play,

Deterding et al. (2011, 11-12) mention the PLEX framework as one which includes both rule-bound play and playfulness. The authors also mentioned that in research of playfulness, it is sometimes equated broadly with any "pleasurable experience" (Costello & Edmonds, 2007, 78; Deterding et al., 2011, 10) or "fun" (Fontijn & Hoonhout, 2007, 119-120; Deterding et al., 2011, 10). Experiences of enjoyment and fun in education were linked to greater retention in a study by Lucardie (2014, 444) and positive emotions are essential for curiosity and the ability to learn new things (Norman, 2005, as cited by Korhonen et al., 2009, 274), so playful design could prove to be useful for gamification of education.

> "The main purpose of playful experience research is to understand what aspects constitute the enjoyment of using a product, what kinds of experiences the product can elicit, and how to design something that elicits a certain kind of experience. Attributes such as 'fun' and 'pleasure' are abstract, and there are uncertainties as to how the different possibilities for supporting playful experiences can be addressed in design." (Korhonen et al., 2009, 277).

Although Korhonen et al. (2009) do not use the term UCD in their article, they state that "Product design needs to improve the support of playful experiences in order to fit in with the users' multi-faceted needs" in the abstract. I argue that this focus on enjoyable playful experiences constitutes as an UCD approach, based on Abras et al. (2004) definition of UCD and Bowles' (2013) characterization of UCD as the dominant design approach within UX. It should be stated though that the PLEX framework does not require the inclusion of users in the design process, which is central to UCD design (Abras et al., 2004, 444-446). Building on the pleasurable experience framework of Costello & Edmonds (2007), Korhonen et al. (2009, 284) devised the playful experience framework to use as "an aestethic tool for the design and evaluation of non-utilitarian features that can make product more engaging, attractive and playful for users". Lucero & Arrasvuori (2010, 29) then refined this framework to 22 categories in *PLEX Cards: a source of inspiration when designing for playfulness.* Morschheuser et al. (2017, 1302) propose the use of such design cards as a tool in the ideation phase of gamification design. The 22 categories of playful experiences used in the PLEX cards are presented in Table 1

Experience	Description
Captivation	Forgetting one's surroundings
Challenge	Testing abilities in a demanding task
Competition	Contest with oneself or an opponent
Completion	Finishing a major task, closure
Control	Dominating, commanding, regulating
Cruelty	Causing mental or physical pain
Discovery	Finding something new or unknown
Eroticism	A sexually arousing experience
Exploration	Investigating an object or situation
Expression	Manifesting oneself creatively
Fantasy	An imagined experience
Fellowship	Friendship, communality or intimacy
Humor	Fun, joy, amusement, jokes, gags
Nurture	Taking care of oneself or others
Relaxation	Relief from bodily or mental work
Sensation	Excitement by stimulating senses
Simulation	An imitation of everyday life
Submission	Being part of a larger structure
Subversion	Breaking social rules and norms
Suffering	Experience of loss, frustration, anger
Sympathy	Sharing emotional feelings
Thrill	Excitement derived from risk, danger

Table 1. PLEX Framework (Lucero & Arrasvuori, 2010, 29)

Table 1 presents the 22 different categories of the PLEX framework identified by Lucero & Arrasvuori (2010). Lucero & Arrasvuori (2010) posit that these categories can be utilized when designing playfulness. This framework was evaluated by Lucero et al. in 2013, who found that it provides a clear advantage over other frameworks and methods in expert evaluation due its simple and intuitive nature. Rigidity and overlap between the categories was identified as a weakness, as well as how little the categories are instantiated in design elements and how different types of playfulness may interact. It was proposed that PLEX is more effective when complemented by other frameworks, such as McCarthy and Wright's (2007, as cited by Lucero et al., 2013, 8) 6 stages of sense-making in experience. (Lucero et al., 2013, 8-9.)

As this thesis uses Deterding et al. (2011) definition of gamification, playful experiences fall outside of its scope. PLEX does showcase however how one could use playful elements in gamification design. Other UCD with a similar focus on pleasurable UX exists, which will be covered next.

3.2. Experience design and psychological needs

Hassenzahl et al. (2013) studied pleasurable UX as well, albeit from the perspective of psychological need fulfilment. In their article on UX, Hassenzahl et al. (2013, 26) showcase how to distill experiences into patterns and then use those patterns to inscribe meaning onto materials to create new (desired) experiences. The article focuses on how to design pleasurable experiences by adhering to the psychological needs of the user. The research on UX was conducted in the broader context of technology in general rather than games or gamification in particular, but as gamification covers design elements and contexts beyond pure games (Deterding et al., 2011, 4), some of the principles could still be applied to gamification.

Hassenzahl et al. (2013) posit that the experience is intangible (need fulfillment), which can be achieved through the material. This material representation is thus "able to constrain context and shape action, emotion, and cognition in line with the envisioned experience" (Hassenzahl et al., 2013, 26). Hassenzahl et al. (2013, 22) define an experience as a "a chunk of time that one went through with sights and sounds, feelings and thoughts, motives and actions… closely knitted together, stored in memory, labelled, relived and communicated to others." These stories (experiences) people tell can be positive or negative (Hassenzahl et al., 2013, 22). According to the article, happiness stems from positive experiences, and positive experiences rely on the fulfillment of psychological needs (Hassenzahl et al., 2013, 21-23).

Lallemand, Koenig & Gronier (2014, 2) also noted that the "fulfilment of human psychological needs is thought to be a main trigger of positive experiences with technologies", and that designers should consider interactive systems as means to fulfill needs and not just means to complete tasks. Thus, according to Hassenzahl et al. (2013), designers can create positive experiences for the player/user by being mindful of and incorporating these psychological needs into their products.

Hassenzahl et al. (2013) propose six potential sources of positivity, noting that some can be added or removed based on the needs of the designer. These six were derived from a set of 10 psychological needs defined by Sheldon et al. (2001, 326) from theories such as Maslow's five universal needs, Epstein's cognitive-experiential self-theory and Self-Determination Theory. The needs are as follows:

Autonomy: A feeling that you are the cause of your own actions rather than feeling that external forces or pressure are the cause of your action.
Competence: Feeling that you are very capable or effective in your actions rather than feeling incompetent or ineffective.
Relatedness: Feeling that you have regular intimate contact with people who care about you rather than feeling lonely and uncared for.
Popularity: Feeling that you are liked, respected, and have influence over others rather than feeling like a person whose advice or opinion nobody is interested in.
Stimulation: Feeling that you get plenty of enjoyment and pleasure rather than feeling bored and understimulated by life.
Security: Feeling safe and in control of your life rather than feeling uncertain and threatened by your circumstances.
(Hassenzahl et al., 2013, 21-23.)

The saliency of these psychological needs in UX was researched and evaluated by Hassenzahl, Diefenbach & Göritz in 2010. The authors collected over 500 positive experiences with interactive products (e.g., mobile phones, computers) and found a clear relationship between need fulfilment and positive affect. Autonomy, competence and relatedness were especially noticeable in reported positive life events, followed by popularity, security and meaning. (Hassenzahl et al., 2010, 352-355).

An extended model of 10 base needs similar to Sheldon et al. (2001) was used in the study, as opposed to the six categories used by Hassenzahl et al. in 2013. The categories were autonomy-independence, competence-effectance, relatedness-belonginess, influence-popularity, pleasure-stimulation, security-control, physical thriving-bodily, self-actualizing-meaning, self-esteem-self-respect and money-luxury (Hassenzahl et al., 2010, 352-355).

The study found that if people experience technology as positive, it facilitates closeness and communication between people, provides new stimulating insights and opportunities for mastery (Hassenzahl et al., 2010, 353-359). However, no claim was made that these would be the definite set of psychological needs central to design of positive experiences, as other aspects such as physical stimulation can become more important with the emergence of new technology (Hassenzahl et al., 2010, 361-362). Brown & Juhlin (2015, 88) note that the experimental work Hassenzahl (2010) discusses in another article has been criticized “on the grounds that the experiments, and their characterizations, miss important parts of what is going on in “The world", that the experiments are staged, and that they don’t provide enough material to inspire design”.

Other observations of note in the article were that randomness or the notion of serendipity might be central to stimulation experiences and emotional expressiveness to relatedness (Hassenzahl et al., 2010, 361). It is of note that both Hassenzahl et al. (2010) and Sheldon et al. (2001) found autonomy, competence and relatedness, the three core components of Self-Determination theory (Proulx, Romero & Arnab, 2017, 85), to be the most salient needs. Sheldon et al. (2001, 329) noted the following in their study on psychological needs:

> *"*As can be seen, self-esteem, relatedness, and autonomy emerged in a three-way tie at the top of the list, suggesting that these are the most salient experiential elements of "satisfying experiences." Competence was close behind, in second position, and thus our hypothesis based on self-determination theory—that autonomy, competence, and relatedness would be among the most important experiential characteristics—received good support*"*.

As SDT has been featured prominently in literature on both gamification and UX design, the next chapter will focus on it.

3.3. Self-determination theory

Self-Determination theory (SDT) is a motivational meta-theory developed by Edward L. Deci and Richard Ryan. It is based on Cognitive Evaluation Theory and research in the effects of external rewards in intrinsic motivation. (Ryan & Deci, 2000b; Proux et al., 2017, 85; Wehmeyer, Shogren, & Toste, 2018). According to SDT, the three key components for motivation are relatedness, competence and autonomy, which are described in the following manner:

> "The need for relatedness is associated with social belonging: it is a satisfaction derived from a sense of connectedness with others; to care and be cared for by others. The need for competence reflects humans' desire to effectively master their environment and experience a sense of competence in that environment. The need for autonomy is satisfied when an individual experiences choice and volition in their action, and perceives themselves to be the origin of their actions. Autonomous actions are those that are self-endorsed, and congruent with one's values and interest." (Wehmeyer et al., 2018).

Przybylski, Ryan & Rigby (2010) used SDT as the basis when studying motivational effect of video games. Przybylski et al. (2010, 155) noted that games have increasingly tapped into the aspects of SDT, as over time autonomy (such as flexible goals) and relatedness (such as online communities) have been incorporated to game designs besides

the competence element provided by challenging gameplay. Their evidence suggests that the broad appeal of games is based on need satisfaction that play can provide, which apply across game genres and content (Przybylski et al., 2010, 163), which supports inclusion of Hassenzahl et al. (2013) work in the previous chapter. In a systematic review of gamification research, SDT was by a large margin the most commonly utilized theoretical/conceptual framework (23) compared to the second (9, Flow Theory) and third (7, MDA framework) most popular choice (Bozkurt & Durak, 2018, 27). SDT was also the most popular motivational theory utilized by the gamification frameworks surveyed by Mora et al. (2017, 537). SDT was also utilized by Sailer et al. (2017) to study motivation in video games.

On a more practical level of gamification, Aparicio et al. (2012, 1-2) method for applying gamification utilizes SDT. Mühlhaus et al. (2017, 76-80) used SDT to create a game-based rehabilitation tool for Parkinson's disease. SDT's relation to video game-based learning was discussed on a more general level in the article "*Learning mechanics and game mechanics under the perspective of self-determination theory to foster motivation in digital game based learning*" by Proulx et al. (2017). In order to achieve growth, people should be able to develop the three following needs: autonomy, competence and relatedness according Proux et al. (2017, 85). Autonomy and competence are also key factors of digital games according to Wouters et al. (2013, 2).

Proux et al. (2017) posit that SDT can be used to foster motivation in game-based learning. In order to develop player's motivation, specifically autonomous motivation which has been linked to positive impact on academic achievement (Taylor et al., 2014) and engagement (Lee, 2005), the game should fulfill four requirements according to Proux et al. (2017, 91-92). Those are the students' goals, feelings of autonomy, competence and relatedness. If these four requirements are met, the game should foster autonomous motivation according (Proux et al., 2017, 92).

Similar approach is used in the effective process of gamification presented by Aparicio et al. (2012). In the effective process of gamification you start by identifying the main objective (the task that you want to gamify) and the transversal objective(s) (underlying objectives that are interesting to players), then create a system based on game mechanics that improve the motivation and interest of the player. This is accomplished by selecting game mechanics that match the objectives and support the needs of human motivation identified in SDT (autonomy, competence and relatedness). (Aparicio et al., 2012, 1-2).

The effectiveness of this model can be analysed and measured through performance, fun, satisfaction and service quality indicators according to Aparicio et al. (2012). Performance can be analysed by comparing values and quality parameters obtained prior to the gamification process to the results obtained after its implementation. The evaluation of fun is based on the analysis of metrics associated with playability defined by González (2010, as cited by Aparicio et al., 2012), which can be achieved via user testing through questionnaires and tests or performing a heuristic evaluation by experts. (Aparicio et al., 2012, 1-2).

In the context of gamification of education, performance of such a model could be measured through learning outcomes. The framework used by Proux et al. (2017) combined the motivational theory of SDT with the game design model of LM-GM (Learning Mechanics Game Mechanics model). The LM-GM model of Lim et al. (2013) is a way to map pedagogical constructs to ludic elements. In it, "the pedagogical elements are viewed as an abstract interface while game elements are deemed as a concrete interface", which means that "pedagogy and its methods are abstract (theoretical and conceptual), while game mechanics are concrete, i.e. by rules or algorithms" (Proulx et al., 2017, 88-91). A similar attempt to map gameplay mechanics to corresponding motivational elements was used in by Lewis, Wardrip-Fruin & Whitehead (2012).

Lewis et al. (2012, 172) studied Social Network Games (SNGs) by Zynga company, which had 246 million players at the time of the article's writing. This was despite the fact that SNGs defy previous assumptions of what makes a game good, lacking many central elements seen to be pivotal for good game by designers such as Sid Meier, Raph Koster and Jane McGonical (Lewis et al., 2012, 172). Studies on player motivations indicate that "players use SNGs as a means of maintaining relationships, and that these relationships provide meaning and incentive to the game actions" (Lewis et al., 2012, 174). I argue that this could be interpreted through the relatedness category of SDT; the social element imbues meaning to the action, which increases player engagement and motivation. For example, one player noted that seeing other players with a higher rank or better game areas encouraged them to play longer (Lewis et al., 2012, 174).

To analyze the lure of these SNGs, Lewis et al. (2012, 172) connected design patterns identified in the games to concepts from behavioural economics and behavioral psychology. The following principles were observed and utilized:

Behavioral economics principles

Anchoring: In the absence of knowing the worth of an item/service, we accept the first price we see as the baseline. Thus proceeding judgements of value are contrasted to this price.

Contrast effect: People have a tendency to perceive things relativistically. A starting car in a race game might feel fast at first, but then slow as you unlock faster cars.

Endowment progress effect: The illusion of progress is enough to provoke accelerated behavior. For example, if you get free coffee with 12 stamps, you buy coffee more frequently the more stamps you have.

Hedonic treadmill: The process in which a person continually strives towards a goal that they believe will make them happy, but upon completion their happiness reverts to a baseline and they start chasing another goal again.

Loss aversion: People are less satisfied by a gain/profit than they are upset by a loss

Reciprocal altruism: Reciprocal altruism observes that even if one were to ignore possible motivations for altruism itself, people will often respond to an action in kind: altruism with altruism, hostility with hostility and so on.

Sunk cost fallacy: The tendency to act irrationally and justify a purchase with sunk costs (costs that cannot be regained; for example buying a membership) – maximizing use of a product/service you paid for to justify it, even to the point of making further losses.

(Lewis et al., 2012, 173).

Behavioral psychology principles

Goal-gradient Hypothesis: The more effort we expend the closer to a reward one we get.

Shaping: a process that uses rewards to train animals to perform more complex behaviors.

Reinforcing behavior: Encouraging certain behavior through positive reinforcement. Three different forms of reinforcement were mentioned, which are:

1. Fixed interval schedule: Reinforcement is given at period of time from original response, regardless of what happens in between that time. Not particularly effective at increasing responses.

2. Avoidance fixed interval schedule: Something negative happens after a fixed period of time unless a response takes place. For example, in *Ultima Online*, player housing degraded if player did not log in regularly.

3. Variable ratio schedule: "Slot machine schedule"; A certain probability of a reward is given, but it's unknown at which response it will play out. This is the most effective one, used in loot-based games such as *Diablo* and *World of Warcraft*.

(Lewis et al., 2012, 173-174).

These principles were then applied to different design elements in the games and linked to similar mechanics seen in other video games, as seen in Table 2. Adopting Bjork & Holopainen's (2005) definition of a game design pattern, Lewis et al. (2012, 174) studied "motivational game design patterns", which they define as "commonly recurring parts of the design of a game that motivate some behavior in a player".

Category	Pattern	Theory	Other Examples
Play space	Harvesting	Fixed interval schedule	*Animal Crossing*
Play space	Withering	Sunk cost fallacy, avoidance interval schedule	*Ultima Online*
Progression	Player level system	Goal-gradient hypothesis	*Role-playing games*
Progression	Quests	Goal-gradient hypothesis, shaping	*Role-playing games*
Rewards	Collections	Intrinsic motivation, material culture	*Bioshock, Skyrim*
Rewards	Currencies	Anchoring	*Microsoft Points*
Rewards	Extrinsic reward for clicking	Variable ratio schedule	*World of Warcraft*
Rewards	Returning bonus	Loss aversion	*World of Warcraft*
Social	Altruistic actions	Reciprocal altruism	*Animal Crossing, Forza Motorsport 3*
Social	Max-level AI neighbor	Contrast effect	*Metroid*
Social	Neighbor bar	Hedonic treadmill	*Leaderboards*

Table 2. Mapping game mechanics to theoretical concepts (Lewis et al., 2012, 175)

Table 2 showcases how Lewis et al. (2012) mapped behavioral theories to game design patterns in their analysis of SNGs. “Patterns”-section of the table contains mechanics observed in SNGs by the study, while “theory”-section contains theories that correspond to the pattern. “Other examples” -section gives examples of other games where the phenomenon can be observed at. (Lewis et al., 2012, 174-178). I posit that a similar framework could be used to analyse gamification elements in educational games.

3.4. Flow and other key theories

SDT has been linked to flow theory, a term coined by Csikzentmihalyi (1975). Flow can be characterized as a “complete state of cognitive absorption or engagement in a task, in which the individual is not affected by thoughts or emotions unrelated to the task.” (Proulx et al., 2017, 85). Kowal & Fortier (1999, 364) found that swimmers who had a self-determined motivation reached the highest states of flow experience while Lee (2005) found that students with higher self-determined motivation were more likely to reach the flow experience and to be deeply engaged in their task. Flow can be conscious or unconscious according to Draper (1999). Whitton (2009, 42) posits that in the context of digital games, being in a state of flow is very similar to being highly engaged. Flow state is something game designers want to provoke in their players (Salen & Zimmerman, 2004; Kapp, 2012, 71). Salen & Zimmerman (2004, 11) support pursuing flow in design on the basis that it induces happiness and a sense of well-being in participants, so I posit that flow could benefit user-centered design.

The concept of flow serves as a good guidepost for gamification of learning according to Kapp (2012, 73). Csikszentmihalyi (2014, 136) notes that games, unlike everyday

environments like school and work, are engineered in a way that facilitates flow by providing clear goals, immediate feedback and balanced challenge. While it is hard to test for flow and designers cannot guarantee that players experience it, designers can create conditions under which it can occur (Kapp, 2012, 71). For example, Nah et al. (2014b, 109-110) mapped game elements to flow components in their study. On a more general level, Csikszentmihalyi (1990) identifies eight components that occur in flow experiences, four of which relate to the cognitive effects of flow such as state of immersion and focus (Salen & Zimmerman, 2004, 10). The other four components are immediate feedback, balance between skills and challenge, a sense of control in the activity as well as clear and attainable goals and rules (Whitton, 2009, 42; Csikszentmihalyi, 2014, 133; Nah et al., 2014b, 86-87).

While the designer cannot affect the cognitive state of the player, they can take into consideration the other components. In order to induce flow, a task should satisfy three key conditions; having clear goals, unambiguous feedback and a balance of challenges and skills (Csikszentmihalyi, 1997; Nah et al., 2014b, 87). Salen & Zimmerman (2004, 8-10) point out the relationship between these prerequisites and game design elements. Clear goals (Nah et al., 2013, 100), unambiguous feedback (Mühlhaus et al., 2017, 77-78) and a balance of challenge (Aparicio et al., 2012) are all game elements identified by game and gamification research. In a state of flow, person always knows how well they are doing, so clear goals and immediate feedback are very important for maintaining focus and concentration according to Csikszentmihalyi (2014, 135). Not knowing how well you are doing, which is to say inadequate feedback, can lead to loss of motivation and distractibility (Csikszentmihalyi, 2014, 135). The higher frequency of feedback video games provide has been recognized as one of the strengths games pose over traditional teaching (Kapp, 2012, 35)

Flow theory, SDT and their relation to gamification are covered more in depth by Kapp (2012), who presents a list of 12 important theories which can help gamification design. These theories and their summaries are presented in Table 3.

Theory	Impact on Gamification Design
Social Learning Theory	Model desired behavior so learner observes and internally processes the desired behavior.
Cognitive Apprenticeship	Setting and environment should be authentic and provide feedback and guidance on the learner's activity.
Flow	Continually adapt to keep the learner at constant state of interest. System adapts to the right challenge level for the leaner, not too difficult and not too easy.
Operant Conditioning	Provide appropriate rewards, points, and badges on a variable basis to maintain learners' interest.
ARCS Theory of Motivation	Grab the learner's attention, contain relevant information, and be aimed at the appropriate level of challenge so the learner is confident he or she will be successful and provide intrinsic and extrinsic motivational elements.
Malone's Theory of Intrinsically Motivating Instruction	Include elements of challenge, fantasy, and curiosity.
Lepper's Instructional Design Principles for Intrinsic Motivation	Include elements of learner control, challenge, curiosity, and contextualization
The Taxonomy of Intrinsic Motivations for Learning	Include internal and external motivational elements such as challenge, curiosity, control, fantasy, cooperation, competition, and recognition.
Self-Determination Theory	Provide the learner with the opportunities for autonomy, a feeling of competence, and relatedness with others.
Distributed Practice	Play out over time to provide spaced repetition of the content within the game.
Scaffolding	Start out providing a great deal of guidance and then provide less and less guidance until the learner is independently solving problems.
Episodic Memory	Evoke learners' emotions to more richly encode the lessons from the game in memory.

Table 3. Theories used in Gamification (Kapp, 2012, 74)

I will utilize these theories in Chapter 7.3.

3.5. Reflective design

Seaborn & Fels (2015, 29) posit that there is a pressing need to explore experimental designs within the context of gamification research. Rilla Khaled's (2018) case study on experimental games *Art Game* and *Johann Sebastian Joust* proposes one potential framework to use in such research in the form of reflective design.

Reflective game design is a critical design practice according to Marcotte (2018). Critical design seeks to challenge, highlight and acknowledge hegemonic design practices and cultural assumptions present in the "status quo" of design. It stands in opposition to affirmative design. These categorizations shift and change over time, as "what was critical today might be affirmative tomorrow" according to Marcotte (2018).

Reflective game design seeks to invoke and trigger reflection in the player. Reflection is a mental process that has been linked to learning, as it features prominently in theories of learning such as constructivism (Piaget, 1985 as cited by Khaled, 2018) and experiential learning (Kolb, 1984 as cited by Khaled, 2018), and has been embraced by education researchers (Solomon, 1987, 270-272; Mezirow, 1990, as cited by Khaled, 2018). According to Khaled (2018, 1-4), games are well suited for triggering and supporting reflection due to their nature of simulating progressively increasing challenges, though the game element of optimal challenge might be detrimental to provoking reflection necessary for learning something out of the play according to Harviainen & Meriläinen (2019, 555). Khaled (2018) posits that several dominant tropes of conventional game design work against reflection, both within the design of entertainment and serious games. For example, commercial games' tendency to emphasize player immersion is a design choice that can hinder or contradict reflection in players according to Khaled (2018, 7-8) and other authors (Harviainen et al., 2014, 65). For that reason, he proposes reflective game design as a new alternative to these dominant (or affirmative) forms of design. The proposed model of reflective design is based on four principles, which are:

> **Questions over answers**: Asking meaningful questions is more important than providing clear answers. Games that prompt questions invite players to be introspective and proactive.
>
> **Clarity over stealth**: Instead of hiding the learning goals, the game should be upfront about them. In focusing on clarity, games designed to trigger reflection promote conscious learning in contrast to accidental learning. Players are supported in focusing on real world connections, in order to maximise the chance that game-derived knowledge will not be segregated

> with "just a game" experiences but integrated with knowledge we use in daily life.
>
> **Disruption over comfort**: Reflection is triggered when we are not strictly comfortable, when our assumptions are thrown into question and when we are confronted by situations that challenge our status quo. Games promoting reflection seek to create moments that lead to disruption and thus embrace designing for surprise, awkwardness and uncertainty.
>
> **Reflection over immersion**: Reflection is not about escapism: it concerns revisiting our previous beliefs intentionally and with a high degree of self-awareness. In the context of games, it requires acknowledging and incorporating the "fourth wall", even if this conflicts with the experience of "being there". Supporting reflection in games calls for privileging reflection over immersion. (Khaled, 2018, 20-22).

Successful educational gamification requires reflection according to Harviainen & Meriläinen (2019, 556), who posit that learning should be improved further if the gamification is able to increase reflection. Reflection should be an essential component of game-based learning according to Whitton (2009, 49) and Harviainen et al. (2014, 73), who stress the importance of debriefing, relating and surrounding gameplay with other activities to foster reflection and connect the learning experience to a larger context. Harviainen & Lieberoth (2012) talk about anchoring learning to existing cultural context or skills, which will help maintain cognitive changes made during play that would otherwise dissipate (Harvianen et al., 2014, 74-75). It is possible to embed moments of reflection into gameplay (Hannula & Harviainen, 2016, 244-255), so storytelling for instance could be used to anchor learning, as storytelling can be used as a tool to induce reflection (Paulus et al., 2006, 357). Reflection has been identified as a key step in the process of learning from stories (Jonassen & Hernandez-Serrano, 2002; Alterio & McDrury, 2003).

Reflective design could provide a way to address criticisms aimed at gamification by moving from pointsification to design that seeks to invoke deeper reflection in the player. As a counter point to shallow and meaningless gamification via pointsification, Nicholson (2012, 6) suggested meaningful gamification, encouraging "a deeper integration of game mechanics into non-game contexts". Salen & Zimmerman (2004, 11) suggest that the best way to create a flow state for players is design meaningful play. Placing more emphasis on the kinaesthethic experience of play could provide one such way to move towards more authenthically gameful design as characterized by Lee & Doh (2012, 34-35).

Game designers and researchers have discussed the importance of responsive and satisfying controls to video games and how there is a lack of standardized vocabulary for describing the phenomenon (Swink, 2007, Dahl & Kraus, 2015, Hicks et al., 2018). The term "game feel" has been used to describe the "tactile sensation of manipulating a digital agent" (Swink, 2007) or "moment-to-moment sensation of controlling games" (Dahl & Kraus, 2015, 41). In *Game Feel: A Game Designer's Guide to Virtual Sensation*, game designer Steve Swink (2008) set out to make a guide on how to make good feeling games. He posits that good game feel stems from seven factors. These are:

> ● **Predictable results**—When players take action, they get the response they expect.
> ● **Instantaneous response**—The player feels the response to their input is immediate. A response time of less than 100 milliseconds is used as a benchmark threshold in the book.
> ● **Easy but deep**—The game takes minutes to learn but a lifetime to master.
> ● **Novelty—**Though the result of an input is predictable, there is enough subtlety and expressiveness to keep the controls feeling fresh and interesting through hours and hours of play. ● Appealing response—The sensation of control is aesthetically appealing and compelling, separate from context.
> ● **Organic motion**—Controlling the avatar creates appealing arcs of motion.
> ● **Harmony**—Each element of a game's feel supports a single, cohesive perception of a unique physical reality for the player. (Steve Swink, 2008, 297.)

According to *Good Game Feel: An Empirically Grounded Framework for Juicy Design* by Hicks et al. (2018, 5), there is overlap between game elements that create a good game feel and juicy design characteristics. Juicy design is a term used for effective, exciting and engaging feedback according to Kapp (2012, 36). Hicks et al. (2018) describe juicy design in the following manner:

> "Juicy design refers to the idea that large amounts of audiovisual feedback contribute to a positive player experience (Gabler et al., 2005.; Jonasson & Purho 2012), and there is anecdotal evidence that some of its elements can contribute to positive player experience and continued engagement (e.g., Gerling et al., 2013; Vanden Abeele et al., 2015). However, while the concept is popular in academic game design communities (e.g., Deterding, 2015; Schell, 2008) and frequently referred to by industry representatives as a means of creating engaging experiences (e.g.,Jonasson & Purho, 2012:"[..]the juicier your game is, the more fun it will be to play")…" .(Hicks et al., 2018, 1).

Incorrect and inconsistent referencing has been fixed from the quote, but other than that it is quoted verbatim in its original context. Based on the article, a link between game feel and user engagement could be established through the concept of juicy design. However, the article has only been cited 4 times at the time of writing (24.03.2020) and it features inaccurate referencing, so it is not a reliable or strong enough of a source to base an argument on. Thus, more studies are needed to establish a correlation between the factors. Still, I posit that the inclusion and prioritization of game feel in gamification design could be an important factor in addressing the criticisms of gamification and moving towards intrinsically motivating gameful design as defined by Lee & Doh (2012, 34-35). Juicy design is one of the design lenses utilized by Deterding (2015,313) in *The Lens of Intrinsic Skill Atoms: A Method for Gameful Design*

3.6. Retention

Student retention is one of the issues that gamification of education seeks to improve (Krause et al., 2015, 95; Pechenkina et al., 2017). When studying the issue of keeping the user engaged and coming back to the product, the term "retention" is used in various different fields and contexts, including education (Wouters et al., 2013) and game design (Miloševic et al., 2017). Modern game developers utilize user data analysis to address retention issues, a few examples of which are presented in this chapter.

Free-to-play (F2P) is an increasingly popular revenue model for the video game industry, in which a game can be "acquired and played for free of charge while players are encouraged to buy virtual goods during gameplay" according to Alha et al. (2014, 1). F2P is sometimes used interchangeably with freemium in a video game context (Alha et al., 2014, 2), as it can be seen as a form of the larger freemium business model paradigm (Luton 2013; Seufert 2013; as cited by Alha et al., 2014, 2). Miloševic et al. (2017, 326) posit that with the advent of the freemium business model, game designers have had to start put more conscious effort into retaining players, as revenue is dependent on optional microtransactions, whereas each customer generates an equal amount of revenue regardless of their play time with games that you purchase for a set price. The two main metrics used in game studies to research the issue are retention and churn; retention measures player the rate at which players continue to play the game, while churn refers to a player who quits playing the game for good (Lovell, 2011). Low churn rates are

directly connected to revenue stability, while a 5% growth in retention can result in 4 times larger profits according Kim et al. (2017, 2).

Viljanen et al. (2017) demonstrated how game designers can utilize the mean cumulative function (MCF) to measure and aid player retention & monetization. According to Viljanen et al. (2017), statistical tools based on the MCF allow game developers to determine whether a given change improves a game, or whether a game is yet good enough for public release. They claim that MCF has unique advantages over existing metrics in interpretation of game quality, player behavior and variance, allowing developers to detect any and all favorable changes to the game. (Viljanen et al., 2017, 3-9)

Stircu (2016) showcased in a similar manner how to use the Waka software to interpret and automate data collected from players to help with churn prevention. The model presented by Stircu (2016, 22) can be used to predict and prevent player churn by selectively incentivizing users that are about to quit the game. There's a direct connection between decreasing user activity and churn rate (Stircu, 2016, 24). According to Stircu (2016, 23-27), software can be used to identify potential churners and automatically trigger and send incentives (campaigns, promotions, gifts/rewards that will help the player to advance) to them to prevent churn.

Milošević, Živić, & Andjelković (2017) proposed a similar pipeline for churn prediction. As more than 70% of all newly acquired users will play a F2P game for only one day, they provide a very limited amount of data to utilize in churn prevention (Milošević et al., 2017, 327). The article explains how that data can be utilized by introducing a model based on it.

The model uses machine learning algorithms Logistic regression, Decision tree, Random Forest, Naive Bayes and Gradient Boosting to classify users into two classes: those likely to churn and those likely to play (Milošević et al., 2017, 327-328). Potential churners are sent push notifications based on the most descriptive data available about the user, based on tracking their feature usage. These messages aim to entice the player to return by explaining something relevant about their favorite game functionality (or by showcasing something they missed) and by carrying a message designed to trigger the users' competitiveness. (Milošević et al., 2017, 328-329). By delivering personalized targeted push notifications, the model was able to increase retention and return 18% of churners

without a cost to the developer in an experiment, as information rather than rewards was used as an incentive (Milošević et al., 2017, 331-332) The gradient boosting algorithm performed the best while the Decision Tree algorithm proved itself to be inadequate for churn prevention (Milošević et al., 2017, 331). Kim et al. (2017, 16) in turn noted that LSTM and gradient boosting algorithms had the best churn prediction performance when analyzing play log data of 193433 unique player records from three different casual games.

As these models aim to aid game developers to maintain players in an existing game, rather than helping to design a new game, I will not address them in this thesis further as they are not relevant to my evaluation framework. Retention can be addressed in the design process as well however, as a game requires adequate content to sustain player retention according to veteran game designer Raph Koster (2019). In his Gamasutra article "*What drives retention?*" (2019), Koster (2019) posits that the game industry is increasingly moving towards "games-as-a-service" (GaaS) business strategy, which relies on long-term retention, comparable to being a hobby. He introduces a list of mechanics proven to drive retention, which can be used synergistically in conjunction with one-another, to utilize when designing for such content (Koster, 2019). The mechanics are as follows:

1: A Steady content trickle.
Pros: Gives a clear aspirational goal. Easily monetized.
Cons: Very expensive, requires regular updates
2: Persistent profile investment.
Pros: RPG-style mechanics. Piling likes and achievements into a profile that accrues over time. Quitting the game means loss of value and social standing in community.
Cons: Works best with a community where you can display your profile to, so you need to build and manage one. New content tends to be added to the top, which can be alienating new players and induce overcomplexity over time.
3: In-world investment (such as player housing).
Pros: The invested value never leaves the game and it anchors the player in. Possibility for collaborative building, which creates social ties.
Cons: Expensive to design and implement, data-intensive to store, design challenges around space.
4: Social connections (such as teams & guilds).
Pros: Social groups are the primary glue in games in general. Social ties introduce a host of powerful retention elements such as mutual obligation, economic exchange, group identity.

Cons: Guilds migrate games as a whole. Adds potential for drama. Requires community management and moderation. Still arguably the most powerful tool in the arsenal according to Koster (2019).

5: Economic play.

Pros: Profit motive will keep players invested well past the point of actual enjoyment.

Cons: If using real money, can chase out more playful ways of engaging players. Balance issues.

6: Extreme depth.

Pros: "The Holy grail of game design". Can be paired with multiple ways to play (for example: speedruns or playing with alternative characters/different classes).

Cons: Extremely challenging to design. High skill ceiling can create issues with accessibility.

7: Player vs Player competition.

Pros: Other players are a free source of depth.

Cons: Zero-sum play (one winner, one loser) causing players to quit. Typical user loses more than wins, while skilled players have disproportionate amount of wins. Modern games use this in combination with design elements like content trickle to ameliorate the problem.

8: User Creativity.

Pros: Can be cheap to build, if player has a chance to monetize this can make it even more powerful.

Cons: Can be very expensive to build if not careful. Requires infrastructure to support sharing, showcasing etc to drive social proof/validation that is an underlying motivation to engage in the behavior.

9: Story.

Pros: The retention tactic of the soap opera. Can gain leverage when combined with the community (Examples: easter eggs and lore help to bond users to the product).

Cons: Same issues as content trickle (which should be defined as consumable gameplay/content). Can be hard to shoehorn into many genres. Retention ends when story arc ends.

10: Emergent gameplay.

Pros: Usually interacts with game breadth as opposed to depth. Can be surprisingly cheap to implement.

Cons: Can be brutally hard to balance, and it can take game into unexpected directions.

(Koster, 2019)

Not only does Koster's article provide valuable insight accrued from a diverse category of highly successful commercial games, it contains interesting parallels to the academic research discussed in this literature review. For example, it could be argued that the "Sunk cost fallacy" discussed by Lewis et al. (2012) could be witnessed in persistent profile investment, as Koster (2019) notes that players can be reluctant to quit playing due to the amount of time invested in their profile. Furthermore, different categories arguably correspond to different aspects of SDT, such as relatedness and "Social Connections".

Koster (2019) raises the point in his article that long-term retention requires habitual use. Understanding how habits work could benefit a designer seeking to improve the long-term retention of his product. Especially in the context of gamification, if the aim is to create a product that either seeks to instill new behavioral patterns in the user, such as reading or exercising regularly, or help them overcome a bad habit such as smoking. In the book *The Power of Habit: Why We Do What We Do in Life and Business* author Charles Duhigg (2012) writes about how we can transform our habits by showcasing results from a number of behavioral and psychological studies and relating them to real life examples from successful individuals, such as Michael Phelps (Olympic swimmer) and Tony Dungy (NFL coach), and organizations such as the Alcoholics Anonymous, Starbucks, Target and Alcoa. The book presents a habit transformation loop for getting rid of negative habits and replacing them with positive ones.

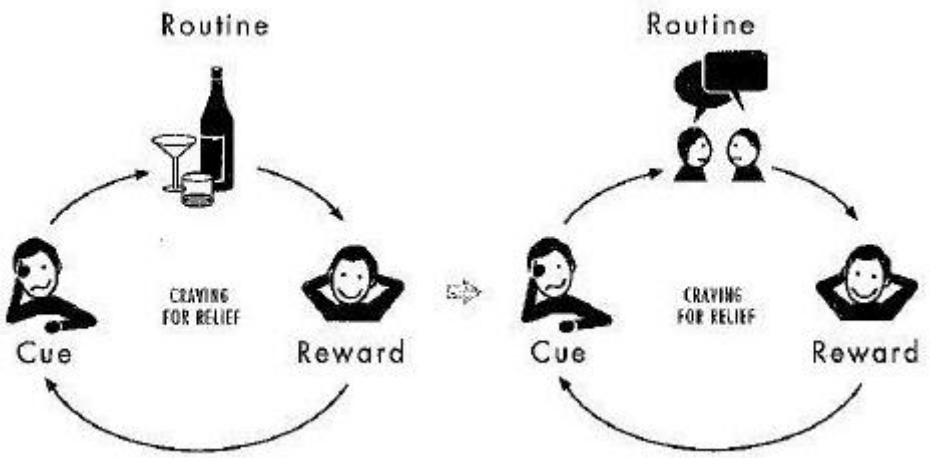

Figure 1. Habit transformation loop (Duhigg, 2012)

Duhigg (2012) posits that we cannot extinguish old habits, but we can turn them into new ones by adhering to the same reward and same cue that prompted the old one and observing what triggers our habits. For example the ingrained habit of taking a smoke break in the middle of the work day can be transformed with a healthier alternative by taking a five minute break to socialize with co-workers, which can be achieved by addressing the root psychological cause and reward (stimulation provided by social interaction at the smoking area) driving the habit according to Duhigg (2012). Faith has been found to be a central requirement for successful transformation of more powerful and severe habits, so establishing an inspirational social environment conducive to change

is important (Duhigg, 2012). The sentiment was echoed in the context of SDT by Wehmeyer et al. (2018), who state the following:

> "SDT posits that such interactions require ongoing social nutriments and supports, and that the social context can either support or serve as a barrier to engagement and, thus, psychological growth, well-being, and the fulfillment of basic psychological needs".

Although Duhigg's best-seller isn't a scientific publication, it has been cited over 1200 times in Google Scholar as of 26.03.2020, including in gamification studies such as *Is it all a game? Understanding the principles of gamification* by Robson et al. (2015, 413). I posit that the habit transformation loop could provide an useful tool for gamification design that seeks to alter user behavior, though I will not address or utilize it further in this thesis.

4 RESEARCH METHOD

Gamification of education was defined by Pechenkina et al. (2017, 2) as use of game elements to increase student engagement and motivation. The definition of gamification by Deterding et al. (2011) that this thesis employs implies that determining whether a system is gamified is based on identification of game elements in it (Huotari & Hamari, 2017, 26). Thus, the framework I will create to evaluate and study gamified products and gamification of education will be based on identification of game elements. As most of the literature on gamification and game elements featured in this thesis did not explain what kind of methodology they used for the identification of these elements, I consulted Lankoski & Björk's (2015) book *Game research methods: An overview* for an appropriate method in my analysis of educational games. Formal analysis of gameplay seemed to align most closely with my research goals as Bjork & Holopainen (2005) used it in their book on game elements and design patterns (Lankoski & Björk, 2015, 23), so it was chosen as my method. In this chapter, I will introduce the methods that I will use to establish a list of game elements to use in my framework in Chapter 5 and its application through formal analysis in Chapter 6.

4.1. Formal analysis

Formal analysis focuses on describing the formal features of a work. In the context of game analysis, these features are game elements, rules and goals (Lankoski & Björk, 2015, 24). Formal analysis of gameplay takes a basis in studying a game independent of context, meaning that it does not regard "which specific people are playing a specific instance of the game" (Lankoski & Björk, 2015, 23). The results it produces can be contrasted or tested against other sources and used for further analysis (Lankoski & Björk, 2015, 23).

The basis for formal analysis is to have a vocabulary that enables clear and distinct description of specific games. One can create or customize vocabularies for individual analyses. (Lankoski & Björk, 2015, 24-25). For example, when using the narrative focused game *Ico* as an example, Lankoski & Björk (2015, 31) augmented their vocabulary by borrowing terminology from film theory on narration, then applied and extended those terms to a video game context.

Formal analysis is conducted by playing a game carefully and repeatedly to distinguish the primitives and later on the principles of design (Lankoski & Björk, 2015, 26-27). Primitives are the building blocks of games. Primitives consist of components (another name for game element), actions and goals (Lankoski & Björk, 2015, 25). Principles of design are a higher level of description, which describe the role of elements in a game (Lankoski & Björk, 2015, 27). The goals of formal analysis determine the needed level of description. Finding the parts of the game that are relevant for the current focus of interest is the first part of formal analysis. (Lankoski & Björk, 2015, 27). Lankoski & Björk (2015, 28) state that as many contemporary games are too big to analyse as a whole, one should distinguish the parts of the game that are relevant for analysis in terms of one's research question. As I seek to identify game elements in my analysis, my analysis will focus on identifying primitives of design.

The quality of formal analysis can be described using the concepts of reliability and validity. Reliablity and validity relate the consistency of the categorization (same vocabulary is always used for the same phenomenon), different researchers describing the same thing using the same concepts (same phenomenon is described consistently) and the description being a good fit to the actual game (Morse et al., 2002, 14-15; Creswell, 2014 as cited by Lankoski & Björk, 2015, 27). Verification is used to maintain reliability and validity. In verification "Data are systematically checked, focus is maintained, and the fit of data and the conceptual work of analysis and interpretation are monitored and confirmed constantly" (Morse et al., 2002, 17). Following strategies can be used to maintain validity and reliability according to Lankoski & Björk (2015, 27-28):

- Providing rich descriptions of the gameplay that is analysed. Other researchers should be able to follow the researcher's description of research and result to follow the researcher's logic and research as well as understand how the research researched to the conclusion
- Provide descriptions of researchers' background, interests etc. to reveal potential biases to the readers.
- Spending prolonged time with the game. The game should be played multiple times, and trying different options how the game system actually works. Better understanding allows better, more nuanced descriptions.
- Constantly checking categories and descriptions in the analysis against their definitions
- Let other researchers check descriptions.

To maintain reliability and validity in my formal analysis of educational games, I need to address five issues according to Lankoski & Björk's (2015, 27-28) methodology. The five issues are to provide A) rich descriptions of gameplay, B) descriptions of my background,

C) spend prolonged time with the games, D) ensure consistency of vocabulary with other researchers' and E) let other researchers check my descriptions. Issue B was addressed in the background section in Chapter 2.1 where I provide a description of my background. Issues A and C are addressed in Chapter 6.1, where I provide descriptions of gameplay from the games I played and studied for my analysis. Issue E is addressed in the attachment from Education Alliance Finland included in the thesis which provides a formal proof that the researchers at the company evaluated and validated my framework and terminology that I use in it. I will address issue D in rest of Chapter 4 and Chapter 5, where I present a methodology for ensuring a consistent vocabulary with prior gamification research, apply it and use it as a basis for establishing my own vocabulary, which I then use in my formal analysis in Chapter 6. In the context of my research, vocabulary refers to the list of game elements and their definitions that I employ.

4.2. Content analysis

To address the issue D of formal analysis, which is ensuring consistency of vocabulary with other researchers, studying the game elements identified by prior gamification research is in order. *Gamification in theory and action: A survey* by Seaborn & Fels (2015) presents a good starting point for establishing a consistent vocabulary of game elements. Across the 31 gamification systems surveyed by Seaborn & Fels (2015, 27), following gamification elements were employed: points (18), badges (15), rewards (11), leaderboards (11), challenges (6), status (5), progression (3), achievements (3), avatars (3), mini-games (2), roles (2), narrative (1), time pressure (1) and feedback (1). The term "gamification element" was used interchangeably with "game element" in the study (Seaborn & Fels, 2015, 20). To see if these 14 game elements could be expanded upon, I will apply content analysis to 10 different studies and books on gamification that weren't included in the survey.

Content analysis is a research tool used to summarize and classify masses of text (Salo, 2015, 169) by identifying the presence of certain words, themes or concepts within the data (Columbia, n.d). Consistency and repetition are identified from the data via coding to reduce its complexity through naming, classifying, combining and categorizing (Salo, 2015, 177). Coding relates to language, symbols and meaning (Salo, 2015, 178) and coded terms can be explicit or implicit, the latter of which are harder to identify and more subject to subjective interpretation (Columbia, n.d). The rules of coding, such as the

degree of implication and alternative spelling options allowed, affect the process and results of content analysis (Columbia, n.d). Salo (2015, 173-179) identifies this as an issue with the method, as data that falls outside the parameters of the coding scheme is often avoided or ignored according to her. Emotional responses, gestures and body language accompanying the responses in the context of an interview are examples of vital data that might not be accounted by the coding scheme (Salo, 2015, 173-179).

As I seek to confirm and expand Seaborn & Fels' (2015) list of elements, I will apply a directed approach of content analysis. Directed approach is based on theory that the researcher seeks to validate or expand (Hsieh & Shannon, 2005, 1281; Salo, 2015, 173). Using existing theory or research can help focus the research question and determine necessary coding schemes (Hsieh & Shannon, 2005, 1281). The main strength of directed approach is that it can support and extend existing theory according to Hsieh & Shannon (2005, 1283). Texts that could not be categorized with the initial coding scheme can be given new codes (Hsieh & Shannon, 2005, 1281), which allows for introduction and analysis of new and important material (Columbia, n.d). In the end, the researcher can conclude how the results confirm those of the theoretical foundation (Salo, 2015, 174), which can be accomplished by reporting the ratio between supporting and non-supporting codes (Hsieh & Shannon, 2005, 1283).

This form of content analysis is therefore guided by pre-defined categorizations (Salo, 2015, 173-174). Its inherent limitation is that the researcher approaches the data with a strong bias and might therefore be more likely to find evidence that is supportive of the theory according to Hsieh & Shannon (2005, 1283). It likely isn't possible to approach data without any preconceptions though (Eskola & Suoranta, 1998, 187), as Salo (2015, 172) notes that the researcher cannot forget his or her prior knowledge, thoughts and observations.

In the next section, I will apply directed content analysis to see if I can validate and expand the theory of Seaborn & Fels (2015). I will do this by following the general steps of conducting conceptual analysis (Columbia, n.d), which are:

1. Decide the level of analysis
2. Decide how many concepts to code for
3. Decide whether to code for existence or frequency
4. Decide on how to distinguish among concepts

5. Develop rules for coding your texts
6. Decide what to do with irrelevant information
7. Code the text
8. Analyze your results

Game elements are the focus, or the level, of the analysis. The 14 elements defined by Seaborn & Fels (2015) will be coded for, but will be expanded on if needed. The frequency of these 14 elements will be counted, and distinguished by applying the game element taxonomy (see: Table 5 in the next section). Irrelevant information will be disregarded. The results and coding will be then discussed in the next chapter.

4.3. Applying a directed approach

The 10 studies for my content analysis were selected from the body of literature I accumulated during my literature review and from common references within those articles. The articles were chosen based on my familiarity with them and the criteria that they present a list of game elements, either in the context of game design theory or gamification research. These articles and the game elements they identify are presented in Table 4. Both theoretical and practical studies are included among that list. Ten ingredients of great games identified by Read & Reeves (2009) were also included due to being referenced in Deterding et al. (2011, 11) definition of gamification, which this thesis uses. Whitton's (2009, 23) ten defining characteristics of games are also included. While none of the 10 articles were featured within Seaborn & Fels (2015) survey, some articles referenced by these articles were covered by it.

Out of the 31 articles employed by Seaborn & Fels (2015, 23), two were included in the 17 articles that Toda et al. (2017) and 34 articles that Dicheva et al. (2015) used in their studies respectively. Seaborn & Fels (2015, 23) and Toda et al. (2017, 151) both referenced McDaniel et al. (2012) and Domínguez et al. (2013), whilst Decheva et al. (2015, 13-14) referenced Domìnguez et al. (2013) and Denny (2013). Out of the 15 studies that Nah et al. (2014a, 402-403) referenced, Goehle (2013) was refenced by Seaborn & Fels (2015, 23) and Dicheva et al. (2015, 13-14) while Berkling & Thomas (2013) was used also by Toda et al. (2017,152) and Dicheva et al. (2015, 13-14). O'Donovan, Gain & Marais (2013) was referenced by Nah et al. (2014a, 402) and Dicheva et al. (2015, 13-14) while Haaranen et al. (2014) and Barata et al. (2013) were

referenced both by Dicheva et al. (2015, 13-14) and Toda et al. (2017, 151-152). Additionally, Dicheva et al. (2015, 13-14) used Nah et al. (2014) as a source, while Kapp's (2012) book on gamification of education, which is presented as a separate entry amongst the 10 articles of Table 4, was utilized thrice (Nah et al., 2014a, 402; Dicheva et al., 2015, 4; Sailer et al., 2017, 373-374). However, not all of elements from Kapp's (2012, 25-50) book were featured in these studies. Thus, some amount of cross-referencing exists between these works.

	Article/Book	**Incorporated/identified game elements**
1	Gamification of Education Using Computer Games (Nah et al., 2013, 103-105)	Leaderboards, Levels/Milestones, Points, Onboarding, Challenges/Quests, Badges, Immediate Feedback, Social Engagement Loops, Teams/Social Dynamics, Rules, Marketplace/Economies, Visual/3D Space/Sounds, Avatars, Customization, Narrative Context, Roleplay
2	Gamification of education: a review of literature (Nah et al., 2014a, 405-406)	points, levels/stages, badges, leaderboards, prizes, progress bars, storyline and feedback
3	Gamification of education (Huang & Soman, 2013, 14)	Points, Levels, Trophies/Badges, Virtual Goods, Storyline, Time restrictions, Aesthetics, Leaderboards, Interactive cooperation
4	The gamification of learning and instruction: game-based methods and strategies for training and education (Kapp, 2012, 25-50)	Goals, Rules, (Conflict, Competition or Cooperation), Time, Reward Structures, Feedback, Levels, Storytelling, Curve of Interest, Aesthetics, Replay or Do Over
5	The dark side of gamification: An overview of negative effects of gamification in education (Toda et al., 2017, 153)	Leaderboards, Badge, Point, Level, Progression, Social Status, Social Interaction, Instant Feedback, Avatar, Economy, Challenge, Narrative

6	Gamification in e-Learning Systems: A Conceptual Model to Engage Students and Its Application in an Adaptive e-Learning System (Klock et al., 2015, 597-599)	Narrative, Rules, Challenges, Integration, Reinforcement and Feedback, Loops of Engagement, Achievements, Points, Levels, Rankings, Badges, Customization, Virtual Goods
7	Learning with digital games: a pratical guide to engaging students in higher education (Whitton, 2009, 23)	Competition, Challenge, Exploration, Fantasy, Goals, Interaction, Outcomes, People, Rules, Safety
8	How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction (Sailer et al., 2017, 373-374)	Points, Badges, Leaderboards, Performance Graphs, Meaningful Stories, Avatars, Teammates
9	Gamification in education: A systematic mapping study (Dicheva et al., 2015, 4)	points, badges, levels, progress bars, leaderboards, virtual currency, avatars
10	Total engagement: using games and virtual worlds to change the way people work and businesses compete (Read & Reeves, 2009, 61-90)	Self-representation with avatars; three-dimensional environments; narrative context; feedback; reputations, ranks, and levels; marketplaces and economies; competition under rules that are explicit and enforced; teams; parallel communication systems that can be easily configured; time pressure

Table 4. Game elements identified in gamification research

Out of the 14 elements identified by Seaborn & Fels (2015), 12 appeared in the articles included in Table 3. In terms of frequency, they appeared in the following articles: points (1, 2, 3, 5, 6, 8, 9), badges (1, 2, 3, 5, 6, 8, 9) and leaderboards (1, 2, 3, 5, 6, 8, 9) were included seven times, avatars (1, 5, 8, 9, 10) was included five times, challenges (1, 5, 6, 7) and feedback (2, 4, 6, 10) four times, achievements (6, 7) and narrative (5, 6) twice while status (10), progression (5) and time-pressure (10) were mentioned once. These

numbers were counted using the same game element taxonomy that Seaborn & Fels (2015, 20) used as the coding scheme and by accounting for both the single and plural form of words such as "challenge".

Legend of game element terminology.

Term	Definition	Alternatives
Points	Numerical units indicating progress.	Experience points; score.
Badges	Visual icons signifying achievements.	Trophies.
Leaderboards	Display of ranks for comparison.	Rankings, scoreboard.
Progression	Milestones indicating progress.	Levelling, level up.
Status	Textual monikers indicating progress.	Title, ranks.
Levels	Increasingly difficult environments.	Stage, area, world.
Rewards	Tangible, desirable items.	Incentives, prizes, gifts.
Roles	Role-playing elements of character.	Class, character.

Table 5. Game element taxonomy (Seaborn & Fels, 2015, 20)

This coding scheme affects the results of the content analysis, as conceptually similar elements with longer or more specific name were not counted for. For example, "roleplay" (article 1) and "reward structures" (4) were not counted as "roles" or "rewards", while "narrative context" (1, 10) or "storytelling" (4) were not counted as "narrative". While it can be concluded that these 10 articles provide supporting evidence for Seaborn & Fels (2015) theory, it is hard to report the ratio between supporting and non-supporting evidence at this point. Coding, categorizing and counting the rest of the elements would ultimately be based on an arbitrary coding scheme. The definition of these elements changes depending on the context, which highlights an issue within game element taxonomies mentioned by Seaborn & Fels (2015, 20):

> "Game elements often interrelate and can bear similar, if not the same, names. For instance,"levels" and "levelling" can refer to ranks acquired by [experience] points, as in traditional role-playing games, but can also refer to stages or areas in a game world."

Content analysis has been criticized for applying quantitative analysis on qualitative content (Salo, 2015, 170) as well as having a reductive and problematic relationship to the data that often disregards the context that produced it (Salo, 2015, 176; Columbia, n.d). For that reason, I posit that trying to quantify the data by counting the frequency of non-supporting codes wouldn't be a productive way to move forward with this analysis. Therefore, I will group conceptually similar codes together here without applying a specific coding scheme and then apply a more qualitative approach in the next chapter to discuss the context and semantics.

Out of the game elements in Table 4 that expand Seaborn & Fels (2015) theory, the most popular was "levels". It was mentioned verbatim by six articles (3, 4, 5, 6, 9) and as Levels/Milestones (1), Levels/stages (2) and Levels and Ranks (10). Kapp (2012, 38-41), article 4 in Table 4, included sub-categorization of game levels, playing levels and player levels in the game element of "Levels". Some of the other elements identified by Kapp (2012), such as Rules and Storytelling also included sub-categorization.

Marketplaces and Economies (Read & Reeves, 2009, 78-80; Nah et al., 2013, 104) and Economy (Toda et al., 2017, 153) were mentioned three times in total, while Virtual Goods (Huang & Soman, 2013, 14; Klock et al., 2015, 599) were mentioned specifically twice and as Virtual Goods/Currency (Dicheva et al., 2015, 5-6). Customization was mentioned twice, as "the way users transform or personalize items according to their preferences" (Klock et al., 2015, 598) and as game content that adapts to the players skills and performance and addressing the player by name (Nah et al., 2013, 105).

Goals were mentioned twice (Whitton, 2009, 23; Kapp, 2012, 28) and rules four times (Whitton, 2009, 23; Kapp, 2012, 29; Nah et al., 2013, 104; Klock et al., 2015, 597) while Read & Reeves (2009, 81-82) talked about "competition under rules that are explicit and enforced" in particular. Competition was mentioned individually (Whitton, 2009, 23) and as part of the category of Conflict/Competition/Cooperation (Kapp, 2012, 31). Cooperation was discussed in terms of Interactive Cooperation (Huang & Soman, 2013, 14), Teams (Read & Reeves, 2009, 82-83), Teammates (Sailer et al., 2017, 374) and Teams/Social Dynamics (Nah et al., 2013, 104). Whitton (2009, 23) used People to account for group play in general.

Aesthetics were mentioned twice (Kapp, 2012; Huang & Soman, 2013) to highlight the importance of graphics and visual presentation in creating an engaging play experience (Kapp, 2012, 46-47), while Visual/3D Space/Sounds by Nah et al. (2013, 104) refers to the same element but also covers audio. 3D environment by Read & Reeves (2009, 66-67) could also be clustered in the same category of audiovisual game elements. Progress bars were also mentioned twice (Nah et al., 2014a, 405-406; Dicheva et al., 2015, 4). Social Interaction (Toda et al., 2017, 153) and Social Engagement Loops (Nah et al., 2013, 103-104) were included as general concept, as well as "parallel communication systems" (Read & Reeves, 2009, 84-86). Engagement Loops were also utilized by Klock et al. (2015, 597-598). Other elements that were only featured once include Performance Graphs (Sailer et al., 2017, 373), Curve of Interest and Replay or Do Over by Kapp (2012,

45-49) and Exploration, Fantasy, Outcomes, Interaction and Safety by Whitton (2009, 23). These elements will be explained and discussed in greater detail in the next chapter, except for interaction, the element of player's actions changing the game state and generating feedback (Whitton, 2009, 23), as this element is ubiquitous in all game actions.

4.4. Discussion

The results of content analysis via a directed approach can be concluded by reporting the ratio between supporting and non-supporting codes (Hsieh & Shannon, 2005, 1283). Because the coded data cannot likely be compared meaningfully using statistical tests of difference, comparisons of frequency can be used to test the validity of content analysis (Curtis et al., 2001, as cited by Hsieh & Shannon, 2005, 1282-1283). However, as it is up to the researcher to decide whether to code for frequency or not (Columbia, n.d), I did not count for it in non-supporting evidence, and thus cannot test the validity of this analysis. As I did count the frequency of the 14 elements of Seaborn & Fels (2015) however, this poses a conflict in my analysis in the form of an inconsistent application of methodology. "Rearranged data isn't a result", Salo (2015, 166-167) states while discussing the common pitfalls of content analysis, calling for more reflexivity about how the information and results were produced and how reliable they are.

My analysis could have been improved by only selecting articles with similar goals as the foundational theory which present a complete list of gamification elements. As some of the articles utilized in my content analysis have different aims and goals than my foundational theory, direct comparison between them isn't feasible. The different goals of these articles could shape the elements they identify and include, which in turn influences the results and their emphasis. The terminology isn't consistent between all of the articles I used.

While not all of the articles in Table 4 are written solely from the perspective of game elements used in gamification of education, all of them feature a set of elements and concepts that can be used in it. Although the terminology varies between descriptions such as "design elements for gamification" (Nah et al., 2014a, 402), "game mechanics" (Huang & Soman, 2013, 14) and "game design elements" (Sailer et al., 2017, 372). Read & Reaves (2009) talk about ingredients of great games, but as their work has a gamification approach which was utilized in the definition of gamification I employ in this work, I chose to include it. By same token I included Whitton's (2009, 23) ten

defining characteristics of games. While she doesn't frame her theory and discussion around game elements, Whitton's (2009, 21-23) work has an educational perspective and her definition of a game aims to be open and inclusive to account for game-like or game-based activities, so it is congruent with gamification.

Establishing more strict pre-determined parameters for how to account for implicit terminology in the coding scheme would have improved the validity and reliability of my analysis. Similarly applying a specific methodology for how the articles are searched, filtered and selected could also improve the scientific reliability of the analysis.

Despite these issues, I posit that my content analysis succeeded in confirming the foundational theory. As I applied the coding scheme of Seaborn & Fels (2015) to my analysis, I used consistent coding throughout the data despite their theoretical differences. As 12 of the 14 elements were identified, the acceptable 80% margin of reliability of content analysis (Columbia, n.d) was exceeded. While non-supporting evidence wasn't coded nor counted in frequency, it was identified, so the foundational theory can thus be expanded on. In the next chapter, I will code this data to new elements. As content analysis has been criticized for applying quantitative analysis on qualitative content (Salo, 2015, 170), I will focus on qualitative analysis of contextual and implicit meaning in this process, so I will not quantify frequencies nor compare their ratios.

To ensure consistency with steps 4 and 5 of content analysis presented in Chapter 4.2, I will use same coding scheme/rules as I did in Chapter 4.3, which is to say that I will apply Seaborn & Fels (2015, 20) game-element taxonomy presented in Table 5. This coherency to coding rules is equivalent to validity in content analysis according to Columbia (n.d). As content analysis allows for such flexible coding (Columbia, n.d) while formal analysis is shaped by the researcher's goals (Lankoski & Björk, 2015, 25-28), I posit that they can complement one another in this context. Flexible coding allows the introduction of new and important material (Columbia, n.d), which can meet the demands of the formal analysis, and in turn improve the consistency of vocabulary used in it. Terminology and definitions can change from study to study, which is something that should be taken into consideration when applying content analysis. For example, the game element "badges" has been defined as a game interface design pattern, game mechanic, game dynamic, motivational affordance and a game component in different studies according to Dicheva et al. (2015, 3).

This variation in terminology highlights the fact that game design elements exist on five different levels according to Deterding et al. (2011, 13), which are game interface design patterns, game design patterns/mechanics, game design principles/heuristics, game models and game design methods. I argue that this contributes to the issues of performing quantitative content analysis on the articles of Table 4 that I've discussed in this section. For example, Dicheva et al. (2015, 4-5) combined levels three and four of Deterding et al. (2011) classification to "educational gamification design principles", and divided game elements into two categories: design principles and game mechanics. Customization for instance is recognized as a design principle by Dicheva et al. (2015, 4), while Nah et al. (2013, 105) classify it as a game element. Other studies included in Table 4 did not present such classification. I need to address this issue in my effort to expand theory and establish a consistent vocabulary, as it is apparent that some elements these articles utilize refer to larger concepts (such as competition or rewards), while others are specific manifestations of these concepts (such as leaderboards or avatars).

Including five levels of categorization would be unpractical in this context, so a simpler model of placing game elements into conceptual and practical categorizations would be a more efficient and less-time consuming method. The LM-GM model maps learning mechanics to game mechanics and could be useful given the educational background, but the game mechanics can be conceptual, such as competition (Arnab et al., 2015, 396-397), so it wouldn't solve the issue in this context. Seaborn & Fels (2015, 27) categorized game elements using Blohm & Leimeister's (2013, 276) game-element taxonomy in their survey, which provides such a model. The game element taxonomy (see: Table 6) categorizes different game mechanics/game elements under game dynamics. A similar model was also created by Bunchball (see: Table 7).

Game mechanics	**Game dynamics**
Documentation of behavior	Exploration
Scoring systems, badges, trophies	Collection
Rankings	Competition
Ranks, levels, reputation points	Acquisition of Status
Group tasks	Collaboration
Time pressure, tasks, quests	Challenge
Avatars, virtual worlds, virtual trade	Development/Organization

Table 6. Game dynamics (Blohm & Leimeister, 2013, 276)

Game mechanics	**Game dynamics**
Points	Reward
Levels	Status
Trophies, badges, achievements	Achievement
Virtual goods	Self-expression
Leaderboards	Competition
Virtual gifts	Altruism

Table 7. Game dynamics (Bunchball, 2010; Simões, Redondo & Vilas, 2013, 4)

Blohm & Leimeister's (2013, 276) model includes a third column after game dynamics titled "motives", but I cut it from Table 6 to make it more uniform with Table 7. According to Blohm & Leimeister (2013, 276), game mechanics are the "building blocks" of gamifying, such as scoring systems or badges, whereas game dynamics correspond to specific user motives. Bunchball (2010, 2-9) also uses the term building block, defining game mechanics as the actions, behaviors and control mechanics used to gamify an activity, while game dynamics illustrate desires and motivations that compel those actions. The term "game mechanics" is used congruently in both works with the definition of game element this thesis utilizes. Bunchball (2010) notes that these dynamics are not always exclusive to one element and that there is interrelatedness amongst them, for example all elements, even self-expression, tap into competition (Bunchball, 2010, 11). I will refer to these two taxonomies as the game dynamics of Blohm & Leimeister and Bunchball from here on out.

SDT could also be utilized as a way to categorise game elements. Aparicio et al. (2012) model of effective gamification is based on using game mechanics that support autonomy, competence and relatedness. Mühlhaus et al. (2017, 77) and Sailer et al. (2017, 371) also designated specific game elements to SDT components. Based on the three layer structure of Blohm & Leimeister's (2013, 276) game dynamics, which moves from game elements to game dynamics to motives, I suggest a model that combines these with SDT, moving in reverse order from base psychological needs (autonomy, relatedness and competence) to game dynamics to game elements, as Proux et al. (2017, 88-91) also used SDT and a theoretical and conceptual division in their study (discussed more in Chapter 3.3). While such a solution cannot address all the issues of this content analysis, I posit that utilizing dynamics and elements as a categorizing tool can help to make different sources more readily comparable with one another, as design concepts and game mechanics will not be grouped in the same category. This should help establish a more consistent vocabulary, which can then help address the issue of validity when I apply it to formal analysis. Combining this with SDT could then allow connection to existing theory, such as the effective process of gamification (Aparicio et al., 2012). Including SDT is also in line with Huotari & Hamari's (2017, 25-26) suggestion to move our conceptual understanding of gamification from application of a set of game mechanics to more broad motivational affordances. In the next chapter, I will create a framework for my formal analysis based on this structure.

5 FRAMEWORK

In this chapter, I present a framework for my formal analysis based on the structure of SDT, game dynamics and game elements. Game elements or mechanics are categorized under nine different game dynamics, which in turn have been grouped under the three different SDT categories that they correspond to the most. "Game dynamics" and "category" will be used interchangeably in this chapter.

I will designate the 14 elements identified by Seaborn & Fels (2015) to concepts (game dynamics) and practical applications (game elements) in this framework. I will do the same for the new game elements that I establish in this chapter, which will be coded based on the game element taxonomy of Seaborn & Fels (2015, 20) utilized in Chapter 4.3. I will use these elements to expand the game dynamics categories created by Bunchball (2010) and Blohm & Leimeister (2013) and establish a consistent vocabulary to use in my formal analysis in Chapter 6.

> "Many contemporary games are too big to be described as whole. For many purposes, first one needs to find a part of the game or parts of games that are analyzed. This require building a rough understanding of the game by playing it and distinguishing the parts that are good candidates for analysis in terms of one's research questions." (Lankoski & Björk, 2015, 28)

In accordance to these instructions, I played educational games first before establishing the vocabulary presented in this category, which in turn influenced the set of elements I needed to include or address in the vocabulary. As my formal analysis seeks to identify gamification elements in educational games, the parts that are relevant for my analysis are game elements (components). For this reason, other sources besides Seaborn & Fels (2015) survey and the 10 articles utilized in my content analysis are referenced in this chapter in situations when a game element identified in my formal analysis is not accounted for by any of the articles.

The interrelation between these elements, although sometimes acknowledged, will not be taken into consideration in this framework. As illustrated by Bjork & Holopainen's (2005) book *Patterns in game design*, which identifies hundreds of game elements, game elements often relate and form hierarchies. For example, experience points are a subcategory of points, which are a subcategory of rewards, and they can relate to player levels and character development, which in turn have ties to concepts such as roleplaying,

status, freedom of choice and self-expression (Bjork & Holopainen, 2005). In terms of formal analysis, these interrelations constitute principles of design (Lankoski & Björk, 2015, 26-27). Incorporating them to would require third level of description, whereas my work only requires first level description, analysis of primitives in form of components/game elements (Lankoski & Björk, 2015, 27).

5.1. Autonomy

Autonomy refers to the feeling of being the perceived origin or source of one's own behavior and experiencing that behavior as self-expression (Deci & Ryan, 2002, 7-8). Thus, the elements in this category relate to feelings of control, choice and self-expression.

5.1.1. Exploration and Experimentation

Freedom to fail, or the ability to experiment freely and fail safely, is a game element recognized by many authors as a key feature of digital games (Whitton, 2009, 23; Dichev et al., 2015, 92; Harviainen et al., 2014, 64; Dicheva et al., 2015, 6), simulations (Crooltall, Oxford & Sauners, 1987) and playfulness (Klopfer, Osterweil & Salen, 2009, 4; Lee & Hammer, 2011, 4) that is lacking (Harviainen & Meriläinen, 2019, 557) or often overlooked (Kapp, 2012, 48) in gamification. Simões et al. (2013, 4) encourage using "failure as a part of the learning process" in gamification. Virtual environments offer a safe space for experimentation, cognitive development, taking risks and exhibiting curiosity (Crooltall et al., 1987; Harviainen et al., 2014, 64-67; Read & Reaves, 2009, 68), and the joy of exploring virtual spaces is a powerful motivator for some players to keep playing (Read & Reaves, 2009, 68). Curiosity is the most direct intrinsic motivation for learning according to Malone & Lepper (1987, 235).

"Replay or Do Over" was utilized by Kapp (2012, 48) to describe the element of being able to reset or replay a mission or a scenario in a game. This can be used to explore rules and test hypotheses virtually without fear of failure or consequences (Kapp, 2012, 48). Whitton (2009, 23) used "safety" to describe activities that have no real-world consequences. Kapp (2012, 40) also used "freeplay" to describe a game mode where learners can play independently without guidance (Kapp, 2012, 39-40). Eleftheria et al. (2013, 4) also referred to a game mode where players can freely experiment as "Free mode". Many games use training levels as a way to acclimatize players so that they do

not have to resort to reading manuals (Whitton, 2009, 123). Exploration manifests in two different ways in these concepts: as exploration of virtual spaces and as exploration of rules in terms of experimentation provided by the freedom to fail afforded by the virtual environment. I've thus grouped the exploration game dynamic of Blohm & Leimeister (2013, 276) with experimentation.

Elements in this category relate to the concepts of free exploration and experimentation. Although none of the literature I reference equates exploration with autonomy, I posit that unguided play and free experimentation correspond to the description of feeling of autonomy stemming from being the perceived source of one's own behavior (Deci & Ryan, 2002, 7). Exploratory learning places less emphasis on teaching by lecturing students and encourages learners to uncover relationships by exploring and experimenting (Lim et al., 2013, 181). While not as well suited for memorization and repetition, it can be used to teach problem-solving skills and and generalised thinking (Lim et al., 2013, 181). In the context of playful experiences, Costello & Edmonds (2007, 80) state that exploration is often linked with discovery, using the pleasure of realizing that you are in control of an action that evokes a reaction in the game as an example of discovery. The pleasure of being in control of an application (Taharim et al., 2013, 23) in turn is accounted as a separate category of playfulness in PLEX (Lucero & Arrasvuori, 2010, 29).

A1 – Continuous Game World

A1 – The game features a freely explorable continuous game world

Nicholson posits (2015, 6) that creating a game world where players can explore, roam and engage with other players is a playful way to engage users in gamification. Game world is the environment in which the gameplay takes place in (Bjork & Holopainen, 2005, 55). Whitton (2009, 29) identifies virtual worlds as a separate concept relating to game worlds. They are game-like environments where users can move around in, interact with people, locations and objects and even create them, but they do not intrinsically have game-elements such as goals, outcomes or challenges (Whitton, 2009, 29). A virtual world is a piece of software that can provide a service and foster a community (Bartle, 2004, 83). According to Bjork & Holopainen (2005, 56), game worlds can be classified into continuous and discrete, based on whether the movement is fluid and continuous or not.

This element corresponds to 3D environments element of Read & Reeves (2009, 66-67), but takes into account 2D environments as well. I define this element as the ability to explore a game world freely without guidance. The game must feature an environment that the player can explore with their avatar or character. Exploration, the ability to investigate a context-sensitive environment, is one of the ten defining features of games identified by Whitton (2009, 23). Player avatars might have abilities such as flying that they can utilize in exploration (Whitton, 2009, 29). It should be noted that level selection tools might visually resemble a game environment and showcase the avatar walking on a path (Bjork & Holopainen, 2005, 60-62), but these are not continuous game worlds if the gameplay doesn't take place in them.

A2 – Freeplay

A2 – The game features a game mode that allows unguided play or experimentation

Based on Kapp's (2012, 40) definition of freeplay as a game mode where players can experiment independently without guidance, this element takes into account unguided play and experimentation that isn't based on exploring game environments and virtual spaces. For example, an art game might provide a blank canvas to the player or a programming game could provide a mode where players can create their own programs. The central facet of freeplay is that these modes will not impose a structured task on the player, but rather allow them to apply their knowledge and experiment freely within the confines of the system**.**

A3 - Replay

A3 – Replay: The game features the option to reset the task

Based on Kapp's (2012, 48) Replay or Do Over, this element accounts for features that allow players to reset their progress and test and experiment hypotheses, either within freeplay or in the confines of structured tasks. Replaying a level or task you've already completed does not constitute as replay by this definition.

A4 – Mini-games

A4 – The game features mini-games

There is no direct definition for a mini-game within the literature I've showcased, but it corresponds to the "games within games" game design pattern (Björk & Holopainen, 2005, 401). Li, Grossman & Fitzmaurice (2012, 105-106) used mini-games as "arcade style bonus levels" designed to be rewarding experiences, rewarding users with them as they progress through highly structured guided tasks. Mini-games are thus small games within games, and their use by Li et al., (2012) implies that they provide less structured/guided freeplay to the player as a reward. While this element could be categorised as a reward, I included it in the autonomy category due to its similarity to freeplay in this context.

5.1.2. Choice and Control

Beyond expressing autonomy via free exploration and experimentation, players can sometimes also make choices within the confines of structured gameplay (Bjork & Holopainen, 2005; Dicheva et al., 2015, 5). Player defined goals, goals and subgoals created or customized by the player according to Bjork & Holopainen (2005, 317), contrast with predefined goals, those set by game designers and usually arranged in a rigid hierarchy (2005, 310). Bjork & Holopainen (2005, 209) posit that games need Freedom of Choice, the ability for players to make choices within the game. Effective learning environments will often present a variety of simulatenously available goals from which the learner may choose (Malone & Lepper, 1987, 232). The importance of control and freedom to facilitating flow in education was underlined by Csikszentmihalyi (2014, 146), who suggests providing more interesting options and productive materials to students so they may take initiative and a more active role. Intrinsically motivated play requires players to have time and freedom to make choices, which can result in deeper learning (Kapp, 2012, 52). Accountability and taking control in learning experience can be viewed as autonomy (Lim et al., 2013, 183).

According to Malone & Lepper (1987, 237-239), the player's control over the game/ learning environment is a key driver of engagement and intrinsic motivation in digital games (Whitton, 2009, 43). Control manifests through contingency, choice and power in Malone & Lepper's (1987, 238-239) work. The amount of control a person has in a

particular environment depends on the range of outcomes that the environment provides and the extent to which the probability of each outcome is influenced by responses available to the person in that environment according to Malone & Lepper (1987, 238). Players' ability to influence gameplay and its outcomes increases engagement and players' stake and sense of ownership of the game according to Whitton (2009, 70). Csikszentmihalyi (1990) posits that the feeling or belief of being in control, which is one of the requisites of reaching a flow state (Whitton, 2009, 42; Csikszentmihalyi, 2014, 133), is more important to people than whether they truly are in complete control or not (Nah et al., 2014b, 87).

I should address the distinction between rules and goals here, as both terms are used in the articles that I reference, sometimes interchangeably. Kapp (2012, 29) posits that at its simplest form, a game is just a set of defined rules. Rules are artificial constraints (Whitton, 2009, 23) which define the objectives and limitations of the game and determine what can and cannot be done by the player (Kapp, 2012, 29-30; Klock et al., 2015, 597). The difference between a game and play is the introduction of a goal according to Kapp (2012, 28). Goals are explicit aims and objectives by Whitton's (2009, 23) definition. The introduction of a goal adds purpose, focus and measurable outcomes into the activity (Kapp, 2012, 28).

Having well-defined and clear goals is important to motivation and engagement (Li et al., 2012, 103; Nah et al., 2013, 100) and clear goals have been used in principles of effective design (Houser & DeLoach, 1998, 320-322) as well as models of designing enjoyable user interfaces (Malone, 1982, 65) and evaluating player enjoyment (Sweetser & Wyeth, 2005, 4-6). Clear goals also provide the player with choices, granting the player "freedom and autonomy" to pursue them using different approaches according to Kapp (2012, 28-29). Clear rules in turn help develop player's internal sense of control (Read & Reeves, 2009, 81) and increases player's sense of control and level of engagement (Nah et al., 2013, 104). Clear goals and rules are also one of the conditions of the flow experience (Whitton, 2009, 42; Csikszentmihalyi, 2014, 133). For that reason, this element was grouped in autonomy.

As per Kapp's (2012, 29) definition rules are an omnipresent element of games, so I will disregard the "Rule" element, based on my interpretation of gamified applications as games in the context of my formal analysis. Goals are included in more specific terms as clear goals and in relation to the concepts of freedom of choice and sense of control on

the basis that they support autonomy. The interrelation of rules, goals and games and their definitions are a subject that could be written extensively about from the perspective of ludology (Salen & Zimmerman, 2004; Schell, 2008, 34-47), but it is not relevant to this discussion, so it will not be addressed further here.

A5 – Clear Goals

A5 – The game sets Clear Goals to the tasks the player performs within the software.

Games often provide visual cues on performance based on goals (Kapp, 2012, 28). Kapp (2012, 28) explains that these cues can be more subtle based on the specific game, or they could be a more concrete design element such as Progress Bars (C6), which provide clear goals according to Sailer et al. (2014, 35). Visually understanding how far you are from a goal provides incentive, feedback, an indication of progress as well as a measurement against other players according to Kapp (2012, 28-29). Instructions should be concise and provided when required by the user, rather than up front at the start of the game when they are out of context and the user wants to start playing as soon as possible (Houser & DeLoach, 1998, 322-325; Whitton, 2009, 144), as people are bad at understanding and remembering information they received out of context or too long before they could apply the knowledge (Glenberg & Robertson, 1999, 18-20; Gee, 2003, 2).

I define Clear Goals as explicit goals stated within software that guide the player's actions. This means that the player does not have to consult a manual in order to play the game, as the case might be with board games. For example, having the objective of "collect five apples" and a counter that goes from 0/5 up to 5/5 as the player collects apples both displayed within the game's interface constitute a Clear Goal. The instructions are clear while the counter showcases to the player how close they are to achieving the goal.

You could argue that "Clear Goal" is not an element, but rather a dynamic, as an element like Progress Bar could be considered to be a manifestation of the concept of "Clear Goals". It was included as an element to account for the popularity of the concept within the literature I've referenced.

A6 – Multiple Routes to Success

A6: The game features multiple ways to progress forward

One of the ways in which freedom of choice is manifested in games is providing multiple routes to success, allowing students to choose their own sub-goals within larger task (Lee & Hammer, 2011, 3; Dicheva et al., 2015, 5), which supports motivation and engagement according to Lee & Hammer (2011, 3, citing Locke & Latham, 1990). Simões et al. (2013, 4) and Kiryakova et al. (2014, 2) recommend giving the player multiple paths to success in gamification to support active learning.

There could be multiple interpretations of this element. For example, one game might require the player to complete five missions out of seven options within a level in order to proceed to the next level, while another game might give the player an option between two different missions or levels, but still require completing both. Or there could be multiple different ways to solve one task or mission, allowing players to devise their individual solutions and strategies to the problems they face. My definition of this element is that it covers every instance of a game giving the player a choice between multiple different tasks/missions/levels, not taking into consideration how linear or non-linear the game is and whether the it only includes the illusions of a choice or not.

A7 – Unlockable Content

A7 – The game features content unlockable via gameplay

Multiple routes to success were grouped with "access/unlocking content" design principle by Dicheva et al. (2015, 5). Eleftheria et al. (2013, 3-4) define the element of unlockable content as either extra challenges or virtual goods (such as customization options or special badges) that contribute to student engagement. Iosup & Epema (2014, 29) define unlocking content as one of their four core dynamics of gamification in turn.

You can unlock different kinds of content in different games. For example, users must achieve at least 4 stars in each level to unlock the next mission in the gamified tutorial system of Li et al. (2012, 106), who posit that this can encourage learning through repetition.

I will not include levels or missions as unlockable content in my definition however, if they are an intended part of the course. If the game allows the player to choose from a

number of different levels which to unlock and/or presents optional levels to unlock, then levels can be considered as unlockable content by my definition. I define unlockable content as tangible game content (customization options, characters, mini-games, optional challenges) that the player can unlock by reaching certain goals. In other words, they are optional goals whose completion unlocks new parts of the game. The terms of these goals must thus be clearly communicated to the player, so that they can consciously choose to attempt them. The content can either be unlocked through direct means by completing a specific goal, or by accumulating enough of rewards (such as virtual currency) to buy or unlock them. Intangible rewards, such as achievements or badges, are not considered unlockable content by this definition, but if an achievement grants player access to an optional level, or a new item that the player character can use, it fulfils the criteria of this definition.

Mühlhaus et al. (2017, 77-81) state that the experience of autonomy could be reached by giving users a choice in the reward system and that structured rewards support a sense of autonomy. Kapp (2012, 33) however includes badges, points and rewards in his definition of a reward structure, and those elements align with competence (Aparicio et al., 2012, 2; Sailer et al., 2017, 371) and collection (Blohm & Leimeister, 2013, 276) and Rewards & Achievements (Bunchball, 2010, 10-11) dynamics. So while unlockable content (and some of the elements in the next category) could be grouped under rewards and other categories that align with competence, I've categorized it as a feature that supports autonomy on the basis of player choice. I will discuss the reasoning behind this line of thinking more in the next section, but I will conclude here that I've categorized rewards that feature an element of player choice and expression here as autonomy features, while I've categorized "passive rewards" as competence features.

5.1.3. Self-expression and Creation

Students can also learn to set to their own goals when engaging in creative activities according to Csikszentmihalyi (2014, 143), who posits that creative activities have less clear goals and feedback, but they can teach children a valuable skill by making them develop personal goals and give feedback to themselves. Creation was translated to expression in PLEX (Korhonen et al., 2009, 279), while Bunchball (2010, 11) used self-expression as a dynamic. Self-expression corresponds to player's need to express their autonomy and originality by marking themselves as having unique personalities, which is often achieved through avatars and virtual goods (Bunchball, 2010, 11). These could

either be earned as a reward, received as a gift or bought with currency (Bunchball, 2010, 11). Blohm & Leimeister's (2013, 276) development/organization game dynamic corresponds to this category most closely, as it includes avatars, but also virtual worlds and virtual trade.

As development/organization sounds nebulous, I suggest replacing with a more intuitive word in the title of this dynamic, such as "customization" or "creation". Klock et al., (2015, 598) define customization as the way users transform or personalize items according to their preferences. It can promote motivation, engagement, sense of ownership and control over the system (Zichermann & Cunningan, 2011, 70-72). The element of control is also accounted in the broader playfulness category of "creation", in which players exert power (Costello & Edmonds, 2007, 80-81) or manipulate (Taharim et al., 2013, 23) the game while expressing themselves creatively. Creating is the highest form of learning in Anderson & Krathwohl's (2001, 31) category of cognitive processes. As creation covers both visual/aesthetic customization elements as well as content created by the player (Costello & Edmonds, 2007, 80-81), I will employ it over "customization" in this dynamic.

The elements in this category thus represent autonomy through the feeling of control and self-expression granted by customizing and creating content in the game. Virtual trade elements are also included in this category, even though not explicitly mentioned. This is something to take into consideration, as you could argue that elements of virtual economy warrant their own category separate from customization, creation and self-expression elements. Different interpretations consider economies to enhance competition (Nah et al., 2013, 104) and social elements and group dynamics (Read & Reeves, 2009, 79-80), and as self-expression ties into differentiating oneself from others according to Bunchball (2010, 11), this category overlaps into relatedness features.

A8 – Virtual Goods

A8 – The game features items or options that can be bought with virtual currency

Virtual goods are elements which enable self-expression through customization, such as new clothes or hairstyles for the player avatar (Klock et al., 2015, 599). They might require a pre-requisite, such a specific rank (Yu, 2011, 27). Dicheva et al. (2015, 5-6) list Virtual Goods/Currency as an element, implying that the virtual goods are inherently linked to virtual currency. Offering players virtual currency for completing tasks instead

of rewards gives them a greater sense of control according to Kapp (2012, 237), as choosing how to spend or allocate the currency allows players to make choices. Virtual currency, which I categorized as a separate element (see: C2), relates to the larger concept of virtual marketplaces, economies and trade, which enable transactions in the virtual world (Nah et al., 2014b, 104).

The definition considers all game content (customization options such as costumes or items, power ups etc) purchasable via virtual currency as "virtual goods". It excludes content purchased via real life currency.

A9 – Character customization

A9 – The game allows customization of player character or avatar

This element covers the ability to visually customize the player avatar or other characters in the game, either through virtual goods / unlockable content, or via character creation. This does not include character development, the improvement of character skills (Bjork & Holopainen, 2005, 224).

As Bjork & Holopainen (2005, 82-83) define game elements that enable player characters and avatars to perform actions as tools, Tool customization could be added as a separate element to account for customization of objects that the avatar can use, such as vehicles.

A10 – Player housing

A10 – The game allows players to construct worlds or customize game spaces / houses

Beyond allowing players to customize their characters, games can allow players to create and customize virtual spaces and objects in them, such as houses. For example, according to Tyni, Sotamaa & Toivonen (2011, 26), FrontierVille encourages self-expression by allowing players to customize both their avatars and buildings and decorate their homesteads. In the context of FrontierVille, homestead is a synonym for the player house. Blohm & Leimeister's (2013, 273) development/organization game dynamic includes virtual worlds. In terms of self-expression and player empowerment, the game design pattern of reconfigurable game world by Bjork & Holopainen (2005) matches customization of virtual worlds the closest in my interpretation. Bjork & Holopainen (2005, 58-59) define reconfigurable game worlds in the following manner:

> "The player can reconfigure the game world itself, including the basic relationships and attributes of the game elements and the rules

> governing the dynamics of these relationships. Three main ways of reconfiguring the Game World are possible: changing the spatial setting, modifying basic attributes of the game elements, and modifying the rules and equations that govern the changes in game element relationships. “

As this pattern can be interpreted in many ways, I will use the word “player housing” in my definition to cover customizable game spaces. Housing refers to game content that the player can build and decorate (Hong, 2014, 53). This element applies if the game features a house for the player character that the player can customize or decorate. It also applies to larger virtual spaces that the player can create and/or customize, for example if the player house has a lawn where the player can place objects and decorations. While there can be a relatedness component to player housing in trying to impress other players with your creations, my definition of the element does not take into consideration whether other players can view or access the player’s house or not.

A11 – Player-generated content

A11 – The players can create and generate new content within the game.

Bjork & Lankoski (2005, 211) state that “some games allow players to perform actions in the Game World that qualify as expressions of creativity”. Nicholson (2012, 4) notes that some games, such as *LittleBigPlanet, Second Life* or *Half-Life*, include systems that allow users to create and modify the games, resulting in player-generated content.

This element ties into element A2 (freeplay), as I define it at as a game mode where the player can experiment freely without guidance and apply their knowledge. For example, making their own programs in a programming game or composing songs in a music game would constitute as player-generated content. This element can have a relatedness component, if players can share their creations with other players, rate and comment on others’ works and so on. However, that aspect does not have to be met in order to fulfil the definition of this element.

A12 – Avatar

A12 – The game features avatars

As there’s conflicting views on whether avatars are an autonomy (Aparicio et al., 2012, 2) or relatedness (Sailer et al., 2013, 35; Sailer et al., 2017, 371) feature, placing them at

the border of the categories seems appropriate. Avatars were described by Sailer et al. (2017, 373-374) in the following manner:

> "Avatars are visual representations of players within the game or gamification environment (Werbach & Hunter, 2012). Usually they are chosen or even created by the player (Kapp, 2012). Avatars can be designed quite simply as a mere pictogram, or they can be complexly animated, three-dimensional representations. Their main formal requirement is that they unmistakably identify the players and set them apart from other human or computer-controlled avatars (Werbach & Hunter, 2015). Avatars allow the players to adopt or create another identity and, in cooperative games, to become part of a community (Annetta, 2010)"

The ability to represent oneself within media via avatars, and exert precise control over that reperesentation, "fundamentally changes the psychology of using technology" according to Read & Reeves (2009, 64). Avatars can help players identify and keep track of information and status visually (Read & Reeves, 2009, 64) and provide an opportunity to optimize self-presentation by projecting a desired version of self (Read & Reeves, 2009, 94-95). They've been tested to produce a measurable heart-beat result in players when compared to game characters that the player did not choose or customize themselves, which is consequential for reactions such as how interested the user is in the experience, how much they remember about it and how long they are willing to participate according to Read & Reeves (2009, 64-66).

Read & Reeves (2009) propose that avatars could help with learning and engagement through mirror neurons. Mirror neurons are neurons which fire when we perform an action, but also when we watch some one else performing that action, allowing us to simulate other peoples experiences and understand better how to perform actions (Read & Reeves, 2009, 96). Avatars could activate these neurons, as Read & Reeves (2009, 97) posit that learning from your own avatar might be easier than from other characters in the game. Kapp (2012, 102) also posits that witnessing an avatar that resembles you performing actions in a digital environment can transfer behavioral changes to players conduct in real world. Books and movies cannot achieve this cognitive effect (Gee, 2003, 3).

While avatar can be defined as the character that you control and perform actions with in the game (Bjork & Holopainen, 2005, 78), regardless of whether the player has any choice on what this character looks like, I define this element as any character that represents the player, chosen by the player. This could mean a purely cosmetic icon selected from a list of options, or a fully customizable three-dimensional game character that the player controls in the game.

5.2. Relatedness

Relatedness refers to feeling connected to others, caring for and being for others and having a sense of belonginess with other individuals and one's community (Deci & Ryan, 2002, 7).

5.2.1. Social Interaction and Engagement Loops

Social Engagement Loops, a concept presented by Zichermann & Cunningham (2011, 67-70) were defined in the following manner by Nah et al. (2013, 103-104);

> "Zichermann and Cunningham [1] suggest four components of an engagement loop: (i) motivating emotion – motivation to use an application such as an educational game, (ii) player reengagement – social or other event entices one back to the application, (iii) social call to action – call to participate in a social event, and (iv) visible progress or reward – recognition for, or rewards of, participation that prompts motivating emotion which begins another loop or cycle. Hence, the social engagement loop repeats and reinforces itself such as in the case of Facebook where users are continually enticed back to the application due to prompts and notifications from their social circles and involvement in associated activities." (Nah et al., 2013, 103-14).

Engagement Loops were also utilized by Klock et al. (2015, 598), who defined them as "creating and maintaining motivating emotions that contribute to the user to keep motivated and engaged in using the system*"*. The elements in this category thus create engagement through motivation stemming from interacting and playing with other people. While relatedness need fulfillment is not fueled by attainment of specific outcomes such as social status according to Deci & Ryan (2002, 7; 2004), status and its acquisition was employed in Seaborn & Fels (2015, 20) taxonomy as well as in both dynamics which I use (Bunchball, 2010; Blohm & Leimeister, 2013, 276) as a motivator, so status elements will be a part of this dynamic.

R1 – Gifting or Referrals

R1 – Players can send gifts or referrals to one another in the game

Altruism is one of the dynamics used by Bunchball (2010). Gifting is used as an example of this dynamic. Bunchball (2010, 10-11) posits that it is an incredibly powerful acquisition and retention mechanic in gamification, as every time you receive a gift, it pulls you back into the application to redeem it. This corresponds to the element of social engagement loops by Nah et al. (2013, 103-104).

Because altruism did not appear as a prevalent dynamic during my formal analysis, it will not be utilized. Referral programs, a popular marketing tactic used by games such as FarmVille and Angry Birds 2 (Bhargava, 2018), function in a similar manner as social engagement loops as gifts. Referral programs incentivize players to invite their friends to play the game by granting them gifts (such as virtual currency or access to a locked feature) for doing so (Bhargava, 2018). For that reason, I categorized gifting and referral programs under the same element.

R2 - Player Level

R2 – The player can level up in the game

Kapp (2012, 37-41) divides levels into three types of levels: game levels, playing levels and player levels. He defines player levels as the numeric level of the player character, which can grow through progression at the game, usually through the accumulation of experience points (Kapp, 2012, 40). The growing level provides a feeling of mastery and accomplishment to the player according to Kapp (2012, 40-41). As both Bunchball (2010) and Blohm & Leimeister (2013, 276) designate levels to the game dynamic of status, I've categorized it in relatedness, although it could be argued that this only applies in a multiplayer context.

This element describes if the player character or user has a numeric level which increases upon progression. In games such as roleplaying games a higher level may unlock new abilities (Kapp, 2012, 41), but whether or not the player level serves any mechanic purpose in the game is irrelevant in my definition.

R3 - Visual Status or Rank

R3 – The game features titles or items that display player status

Ranks, reputations points and titles (Blohm & Leimeister, 2013, 276; Seaborn & Fels, 2015, 20) are some of the reoccurring elements categorized under status in game dynamics. Seaborn & Fels (2015, 20) define status as "textual monikers indicating progress". Dicheva & Dichev (2015, 1145-1146) systematic mapping study of empirical research on applying gamification to education found "Visible Status" as the most utilized gamification design principle in an educational context. While Dicheva & Dichev (2015) do not provide a working definition for visible status, Read & Reeves (2009, 94) posit that avatars help players to identify player's status among other things. Nah et al. (2014, 406) also state that character upgrades are a good way to motivate learners by displaying their progress, which allows others to "recognize the amount of effort the player has spent to reach his or her current level".

Based on these assumptions, I posit that player status can also be indicated through items that the player wears. For example, in the game *World of Warcraft*, armor sets that the avatars can use are divided hierarchially to tiers based on the difficulty of the content they are obtained from (WoWpediaa, n.d), or they might require a sufficient "arena rating" gained by competing against other players succesfully (WoWpediab, n.d). In such a scenario, an item that the avatar wears can be a visible status indicator to other players. For that reason, I chose to the term "visual status" for this element, as it can be interpreted to cover both textual monikers such as title, as well as items that visually indicate the player's status.

R4 – Friend list

R4 – The game features a friend list

The inclusion of this element is not based on research, as it is an element I identified during my formal analysis. As the name implies, this element covers the feature of being able to add friends to a friend list within the game. The feature can be utilized to make the organization of group activities easier. I posit that it could be linked to status seeking, motivation and competition as well, as game services such as Steam and PlayStation Network can showcase the achievements, badges and level of the people in your friend list.

R5 – Chat or messaging

R5 – Game features a way for players to communicate with one another

Written and spoken communication enables much of the social engagement in video games (Read & Reeves, 2009, 84). Messages and chat are some of the elements that support relatedness according Aparicio et al. (2012, 2). Social Interaction Social Interaction is when two or more players have two-way communication between each other, i.e., the other players can respond to the individual player's communication. (Bjork & Holopainen, 2005, 259)

This element covers features that allow players to interact with one another, whether through written messages or voice communication. The communication may happen instantaneously between players through instant messaging tools such as chat (Read & Reeves, 2009, 85), or with messages, such as player mail in World of Warcraft or messages in Dark Souls. This means that the definition also covers non-direct messaging.

5.2.2. Narrative and Visual Context

The four basic elements that a game consists of are mechanics, story, aesthetics and technology according to Schell (2008, 41-42). Kapp (2012, 74) in turn uses aesthetics in his definition of gamification. Aesthetics are a "large area of study concerned with human appreciation of beauty and how things are felt, judged and sensed" (Benyon, 2010, 108), which describe art, beauty and visual elements (Kapp, 2012, 46) or how the game looks, sounds, smells, tastes and feels like (Schell, 2008, 42) in context of game design. They create a look or a tone for the experience that tie other parts of the design together and ideally mechanics and story should work synergistically with aesthetics (Schell, 2008, 42). In the MDA framework, which is sometimes used in gamification frameworks (Mora et al., 2017, 525), players experience game mechanics and dynamics through aesthetics (Hunicke, LeBlanc & Zubek, 2004, 2, Mora et al., 2017, 520), though they are defined differently in its context. Schell (2008, 347-349) also suggests that aesthetics serve to visualize abstract concepts of game design, and that they can help to make players take the game more seriously by making the game feel more real. Aesthetic value can also be viewed as a source of intrinsic motivation (Schell, 2008,

357; Vahlo, 2018, 258). Kapp (2012, 46-47) posits that educational games disregard aesthetics too often, which can cause the user experience to be less engaging and compelling. Whitton (2009, 63) also suggests that educational games might fail to engage players accustomed to the graphical fidelity and production values of commercial games, but argues that it is not sensible or even feasible for educational games to try to compete with such standards (Whitton, 2009, 136-137). Humorous and quirky low-end graphics can be a selling point (Whitton, 2009, 63), and the overall style and aesthetic is more important than high level of visual detail or realism (Kapp, 2012, 46-47).

Ferguson et al. (1993, 99) claim that appropriately told stories help learners form useful connections between their prior memories and information embedded within the story, which will help them to retain and remember the lesson in the future. The ideal context for hearing a story is when being engrossed in a task which the story relates to and offers appropriate advice (Adams et al., 1988, 173; Ferguson et al., 1993, 99). Narratives are a powerful medium of learning (Rossiter, 2002, 5), and narrative devices such as plot, characters and stories have important pedagogic benefits such as stimulating curiosity and engagement (Moseley, 2008, 6; Whitton, 2009, 69-70). Links between narrative and engagement have been researched in educational literature (Rossiter, 2002; Paulus et al., 2006).

Storytelling is an essential part of the gamification of learning and instruction according to Kapp (2012, 41). It engages audiences in something that becomes real because they can imagine themselves in the same narrative space according to Read & Reeves (2009, 69). Kapp (2012, 42) identifies characters, plot, tension and resolution as the elements of storytelling. The game element of "story" provides relevance and meaning to the experience and context for the application of tasks (Kapp, 2012, 41), and it gives players a sense of purpose and develops their understanding (Moseley, 2008, 6). Narratives guide action and organize character roles, rewards & group action (Read & Reeves, 2009, 68), embed activities within a purposeful context (Whitton, 2009, 146) and allow players to see the relationship between past and present and present and future (Nicholson, 2015, 6). Read & Reeves (2009, 69) state that stories are important to thinking, emotional experience and social expertise. They do not have to be fictional or fantastic, as stories can fit into real-world themes such as history or news as well (Moseley, 2008, 8; Whitton, 2009, 69; Benyon, 2010, 100). Sailer et al. (2017, 375) also

classify meaningful stories as a game element that corresponds to social relatedness, stating that narrative context contextualizes activities giving them meaning (2017, 373). Schön (1984/1993, as cited by Paulus et al., 2006, 357) encouraged the use of stories as a way to engage learners in reflection.

As narrative context corresponds to social relatedness and works on providing context and meaning to an action according to Sailer et al. (2017), I posit that aesthetics could do the same, based on Kapp (2012, 42) talking about both narrative and visual context in his chapter on storytelling. The game design pattern of identification could draw a connection between aesthetics and narrative. Bjork & Holopainen (2005, 228) define identification as the "characters or parts of the game with which players identify", stating that players need something to care about within a game to feel any attachment to it. Hassenzahl, Schöbel & Trautmann (2008, 473) describe identification as relatedness through communication of identity. Social learning theory posits that close identification between learner and the model makes learning more likely to occur (Lim et al., 2013, 181). Identification can be created by using characters or avatars, and it is linked to narrative structures as well (Bjork & Holopainen, 2005, 228-229). The purpose of using exposition (narrative) in gamification according to Nicholson (2015, 6) is to provide players with "additional ways to be connected to the real-world setting". Nah et al. (2013, 104) "Visual/3D Space/Sounds" and Read & Reeves' (2009, 66) "3D environment", which were linked together with aesthetics among the 12 new game elements identified in Chapter 4.2, both emphasize the importance of real-world identification in virtual spaces.

Based on those assumptions, both narrative and aesthetics can make the game world more tangible and relatable to the player through identification. Thus, I posit that aesthetics can be categorized in two different ways based on the context. It can mean the art style and visual presentation that lends the game its theme and by proxy, narrative and visual context (Kapp, 2012, 42), to help with player identification. Or it can relate to individual elements on how the game looks, sound and feels per Schell's (2008, 42) definition, in which case it corresponds to the audiovisual feedback category I included under competence. Nah et al. (2013, 104) Visual/3D Space/Sounds also corresponds to auditory feedback, while Read & Reeves (2009, 66-68) 3D environments feature elements of exploration, so it was linked to element 1A as well.

It should be reiterated that only Sailer et al. (2017) directly categorized a narrative game element with relatedness, while no one equated visual elements or aesthetics with relatedness. Thus, the placement of this category is only based on my personal interpretation of visual and narrative context working the same way through identification, which Hassenzahl et al. (2008, 473) attributed to relatedness.

R6 Simulation aesthetics

R6 – The aesthetics and theme emulate reality

The simulation category of playfulness corresponds to the pleasure of seeing representation of a real-life object or concept within a game (Costello & Edmonds, 2007, 81). Games' ability to simulate and demonstrate real-life concepts and experiments that are hard or risky to do in real life (such as nuclear reactions) with visuals is one of the educational advantages Nah et al. (2013, 104) identify with the game element of visuals/aesthetics. Kapp (2012, 46-47) posits in his definition of aesthetics that these graphics do not have to be highly realistic or detailed.

I define this element as aesthetics or visual style that simulates real-life activities, situations, settings and areas (such as countries or specific geographic locations). The graphical style can be stylized or cartoony, as long as the visual and narrative content or theme of the game focuses on simulating real-life concepts. A game with anthropomorphic characters would also fall under this classification in this definition, if they perform mundane activities in a contemporary setting that simulates real life. These points of references to real life concepts provide objects and characters for players to identify with.

R7 Fantasy aesthetics

R7 – The aesthetics and theme are based on fantasy

This element offers a counter point to R6, embracing video games potential to create magical domains unbound by the laws of real life. Costello & Edmonds (2007, 81) include fantasy as a category of playfulness corresponding to the "pleasure of perceiving a fantastical creation of the imagination". Malone (1982, 65) outlines fantasy as one of the main appeals of computer systems. He posits that fantasy is "probably the most important feature of computer games that can be usefully included in other user

interfaces". He defines fantasy as evoking mental images of physical objects or social situations that are not actually present (Malone, 1982, 65-67). Whitton (2009, 23) uses fantasy, "existence of a make-believe environment, characters or narrative", as one of ten defining features of games. According to Malone (1982, 67) fantasies in computer games derive some of their appeal from the emotional needs they help to satisfy, but can also make systems easier to learn and use by being analogous to things which the users are already familiar with (Malone, 1982, 67).

This element accounts for games set is imaginary fantasy settings. This does not just include the fantasy genre, but science fiction and other fictional and imaginary settings not based on simulation of real-life. Whether historical settings are considered simulation or fantasy is a matter of interpretation. For example, Li et al., (2012, 108) used fantasy as gamification element by designing a backstory based on the Apollo program. I will utilize Costello & Edmonds (2007, 81) definition of fantasy and strictly limit this element to "fantastical creations of the imagination" in this context, excluding such interpretations.

R8 – Characters/NPCs

R8 – The game features distinct characters that interact with the player

Characters have been discussed as an element of storytelling and narrative (Rosseter, 2002; Paulus et al., 2006; Dansky, 2007; Moseley, 2008, Benyon, 2010). One of the main functions of game narratives according to Dansky (2007, 6) is to enable players to identify and emotionally connect with characters. Players can empathize and emotionally engage with characters (Moseley, 2008, 6; Whitton, 2009, 66), which is a powerful factor in learning according to Whitton (2009, 66). Paulus et al. (2006, 370) posit that while often ignored, this emotional engagement may be a key part of the learning process and reflection. Through characters stories can showcase other people's perspectives and stimulate empathic response in players (Rosseter, 2002, 3).

Kapp (2012, 42) defined characters as one of the four elements of storytelling, although he did not provide a definition for a character. Bjork & Holopainen (2005, 222) define characters as abstract representations of persons in a game. The term non-player character (NPC) is used to refer to characters controlled by the game (Sailer et al., 2017, 373). The

player can often interact with NPCs in certain game genres such as roleplaying games (Whitton, 2009, 59).

I define this element as the game featuring distinct NPCs that the player can interact with in the game world, or that interact with the player during cutscenes and tutorials, providing narrative context and instructions. Characters by this definition have distinct personalities, such as a name and a unique voice, differentiating them as unique entities within the game world. Mascots and anthropomorphic animals classify as characters.

R9 – Narrative Context

R9 – The game provides a narrative context for its content

Narrative context or theme of a game keeps people engaged in it according to Nah et al. (2013, 105), who state that we relate to a game better if it is grounded in a narrative context that has a storyline. This element measures if the game has a narrative context to frame the action. The game doesn't have to have an elaborate storyline by this definition, just a justification for the tasks the player is asked to perform within the narrative confines of the game world. A simple illustration of this concept would be to compare math problems given to a first grader with highly advanced math tasks: a math problem aimed at very young children might give a narrative context for the task (such as counting apples) to ground it in reality, while math problems aimed at teens or adults are more likely to be formulated in a purely abstract manner.

An argument could be made that "storyline" or "storytelling" (which could be include concepts such as environmental storytelling) should also be included as a separate entry. Branching dialogue (Gay, Leijdekkers & Pooley, 2016, 122) and non-linear storylines are prominent feature of video game narratives, so they could also be featured as separate elements. Offering meaningful choices within stories can support players' autonomy according to Sailer et al. (2013, 35). Whitton (2009, 70) also argues that players' ability to influence storyline and its outcomes increases their engagement and sense of ownership of the game.

R10 – Cutscenes

R10 – The game features animated videos used in storytelling

Bjork & Holopainen (2005, 233) define cutscenes as "sequences of storytelling where players cannot act within the game". They are used when games cannot progress the entire game story through actions and events and need to give longer descriptions and explanations to players (Bjork & Holopainen, 2005, 233; Dansky, 2007, 4). Cutscenes are often videos which are either streamed from a video file or rendered using gameplay graphics (wikipedia, n.d).

5.2.3. Collaboration and Competition

Social interaction, which manifests through competition, collaboration or sharing a gaming space, is one of the three primary motivators for playing digital games identified in Whitton's (2009, 38-39) study. Bjork & Holopainen (2005, 237) divide game design patterns for social interaction into four different categories: competition, collaboration, group activities and stimulated social interaction. Kapp (2012, 31-32) also groups competition and conflict together as the same element. Huang & Soman (2013, 13) divide gamification elements into two categories, "self-elements" and "social-elements", the latter of which consists of interactive competition and cooperation. Bjork & Holopainen (2005, 237) note that "although social interaction in general is viewed as something where the players do things together, the means to that interaction often involves conflict and competition between the players". Inter-group competition can add an element of collaboration to competition and reduce the negative side effects of competition according to Whitton (2009, 124). Due to this relation, both cooperation and competition between players has been grouped together under relatedness. I posit that competition is where relatedness and competence elements can start to overlap.

R11 – Teamwork

R11- The game features teamwork between players.

The importance of teams (Read & Reeves, 2009, 82-84), teams/social dynamics (Nah et al., 2013, 104), teammates (Sailer et al., 2017, 374) and interactive cooperation (Huang & Soman, 2013, 13-14) to social interaction and engagement in games has been raised by many authors. Team play (Bjork & Holopainen, 2005, 247-248) and cooperation (Kapp, 2012, 32) describes players working together in a group or a team to reach common goals

and achieve mutually beneficial outcomes. According to Kapp (2012, 32), that is the social aspect of games that many players enjoy. Making players compete against the game system itself as groups or teams can promote sharing of knowledge and enhance social learning (Harvianen et al., 2018, 68-69). Cooperation can be fostered by offering advanced players achievements for assisting less experienced players (Kapp, 2012, 237).

Instead of "team play" or (interactive) "cooperation", I chose the word teamwork to signal the element of players working as a team due to the connotations of the word. This definition seeks to designate this element as group work between human players who are playing together at the same time. I consider the multiplayer component to be critical, as the next element allows a counterpoint to this element. Sailer et al. (2017, 374) note that teammates can be NPCs as well, but I chose to define this element as co-operation that occurs between human players to emphasize the relatedness feature of the element. As a single player game might emulate a multiplayer experience by providing NPC teammates to player, and a multiplayer game can feature NPCs working with groups of human players, you could create further categories to distinguish between these types of groupwork.

There are many different types of teamplay and cooperation between players in video games. This element simply seeks to encapsulate both the terminology of cooperation and teams, teammates and group tasks. For example, players do not have to be together in a group in order to cooperate. And there are sub-categories within teams that could have their own dedicated elements, such as player guilds (O'Donovan et al., 2013, 251) or alliances (Bjork & Holopainen, 2005, 250).

R12 – Collaborative Actions

R12 – Game features objectives that require collaboration between players

To account for non-direct cooperation between players, such as peer-reviewing, this element tries to address forms of social/cooperative play that fall outside of direct teamwork and multiplayer gameplay. While "Collaboration" has been used as a game dynamic (Blohm & Leimeister, 2013, 276) or category (Bjork & Holopainen, 2005, 237) under which co-operative game elements and group tasks fall, its subcategory "Collaborative Actions" could be interpreted to fulfill such a role. Bjork & Holopainen (2005, 246) define the game design pattern of Collaborative Actions in the following manner:

> "Every mode of play where the players perform actions together for mutual benefit requires Cooperation from basic Collaborative Actions to Trading and even Bidding. The benefit does not have to be direct to all the cooperating players but there can be a time delay for the Individual Rewards as is described in Delayed Reciprocity."

No direct explanation or definition is given for Collaborative Actions however. As the benefit doesn't have to be direct for all cooperating players, I interpret this element to cover collaborative actions such as peer-reviewing, where one player helps another player by giving them feedback. According to Jenkins (2005, 50), this act of sharing information between players through peer-to-peer teaching improves learning and provides them a sense of empowerment and expertise.

R13 – Player roles/classes

R13 – The game features different roles for the player to choose from

Roleplaying is acknowledged as an important game element by Nah et al. (2013, 105) and one of the oldest gamification techniques by Harviainen & Meriläinen (2019, 555). Roleplay gives meaning and relevance to a game according to Nah et al. (2013, 105), so adding the component of roles to tasks can increase interest (Crooltall et al., 1987, 153-161) and engagement in learning (Nah et al., 2013, 105), which works well for certain topics like language learning (Harviainen & Savonsaari, 2013; Cruaud, 2018). Role-playing has also been used by teachers to help students understand subjects such as global politics and historical events from different perspectives (Jenkins, 2005, 51).

A common feature of roleplaying games is the use of statistical models which provide numeric scores for the player characters' different attributes, which influence the characters' abilities and weaknesses (Whitton, 2009, 59). The concept of roleplaying contains both elements of player character and class (Bjork & Holopainen, 2005, 252; Seaborn & Fels, 2015, 20) and the use of experience points as a reward to increase the player characters' level (Kapp, 2012, 40-41), the latter of which can be witnessed outside of roleplaying games as well. So, the question of how to incorporate roleplaying as an element rises.

Bjork & Holopainen (2005, 237) categorize roleplaying as a group activity amongst game design patterns for social interaction, stating it can promote team play (2005, 254). Kapp (2012, 32) in turn states that players must often team together with other

players of different classes in roleplaying games in order to overcome obstacles or accomplish a goal. This is based on roleplaying games' utilization of character classes or roles, character types with different skills and abilities (Bjork & Holopainen, 2005, 252-254), which facilitates a co-dependency/group dynamic. As this ties to element R12, teamwork, I categorized this element in the same group

To correspond to the Seaborn & Fels (2015) element of "roles", this element accounts for whether the game includes different, mechanically distinct, player classes or roles within the game. Although it's categorized as a Collaboration and Competition based element, this definition does not take in account whether the game includes teamwork/multiplayer component or not. Player classes could be utilized in gamification by taking into consideration different student's skill-levels and personalities according to Iosup & Epema (2014, 28), who propose the use of four player type framework of Bartle (1996).

It should be noted that other elements could be based on roleplaying as well. It carries ties to other dynamics and categories such as self-expression, as customization of the player avatar and players' identification with their characters are a part of the appeal of roleplaying according to Bjork & Holopainen (2005, 253). Roleplaying games in particular have the power to harness players' empathy and emotional engagement with characters according to Whitton (2009, 69). Roleplaying can also enhance engagement in learning by giving meaning and relevance to a game (Nah et al., 2013, 105), so it could be used to provide narrative context as well.

R14 – PvP Competition

R14 – The game features direct real-time competition between players

PvP stands for player versus player competition (Koster, 2019). Competition between players can happen in real-time, or players playing at different times can compete against each other through means such as scoreboards or leaderboards (Whitton, 2009, 23). As Bjork & Holopainen (2005, 237-238) divided competition to direct and indirect competition, I've limited this competition to direct real-time competition. This competition can happen between individual players or groups of players competing against each other.

This contrasts it to elements such as leaderboards, where competition can be indirect. I posit that this line is where relatedness shifts to competence.

5.3. Competence

Competence refers to experiencing opportunities to exercise and express one's capacities, and the need for it leads people to seek challenges that are optimal for their capacities (Deci & Ryan 2002, 7).

C1 – Leaderboards

C1 – The game features leaderboards or a high score

Rankings, which are equivalent to leaderboards by Klock et al. (2015, 598) definition, correspond to competition dynamic of Blohm & Leimeister (2013, 276). Bunchball's (2010) competition dynamic also covers leaderboards. While leaderboards are a social competition element according to Huang & Soman (2013, 13), they support (Aparicio et al., 2012, 2) and positively affect competence need satisfaction (Sailer et al., 2017, 371). O'Donovan et al. (2013, 244) also note that leaderboards create both competition and a sense of belonging to a similar minded group. Leaderboards which provide a team-score can foster team members feelings of social relatedness according to Sailer et al. (2013, 34). For that reason, I've grouped leaderboards under Competition and Collaboration category, but labelled them as a competence element.

Leaderboards rank users based on their performance, based on metrics such as the amount of points and badges acquired (Dicheva et al., 2015, 4). They are used to create a competitive environment among students by displaying high scores (Nah et al., 2014a, 406). According to Nah et al. (2014a, 406), leaderboards usually display only the top 5 or 10 scorers to avoid demotivation for those with a lower rank. The results of O'Donovan et al. (2013, 251) study on gamification of a university-level course indicate that leaderboards are the most highly motivating element out of virtual currency, ranks, progress bars, badges and leaderboards.

5.3.1. Progression and Rewards

Points are one of the most ubiquitous game elements in the gamification research I've referenced, but what exactly do they entail? Points are the "basic scoring schema" used to "indicate progress" (Nah et al., 2013, 103) or "quantify user performance" (Dicheva et al., 2015, 4) in a game. Sailer et al. (2013, 34) define points as immediate positive reinforcement. They can be used to claim rewards, so they can be also seen as a basic component of the reward system (Nah et al., 2013, 103) or as virtual rewards (Sailer et al., 2013, 34). Fu (2011, 27) defines points as a form of virtual currency. I posit that rather virtual currency can be considered one of the forms of points. Points can thus be used both for scoring and as reward systems. Seaborn & Fels' (2015, 20) taxonomy uses points to refer to experience points and score, while points are categorized under the reward dynamic of Bunchball (2010) and included among badges and rewards in reward structures of Kapp (2012, 33). The collection dynamic of Blohm & Leimeister (2013, 276) corresponds to scoring systems, badges and trophies in turn, while Bunchball (2010) groups badges, trophies and achievements in the achievement dynamic.

While there is no uniform vocabulary across these categorizations, based on them we can postulate that points correspond to a reward dynamic, which includes/relates to badges, trophies and achievements. I posit that the collection dynamic of Blohm & Leimeister (2013, 276) shares similarities with the completion element of the PLEX framework, which describes the closure and satisfaction provided by finishing a major task (Lucero et al., 2013, 223). Based on Nah et al. (2013, 103) characterisation of points as indicators of progress and Toda et al. (2017, 153) game element of progression (no definition), I chose to name this category as Progression and Rewards. This dedicates this category to game elements that measure and provide feedback on the players progress, the incentives used to motivate player to reach goals and the rewards awarded for completing these tasks. Completion-contingent rewards bolster feelings of competence if the task requires skills and the player has established an understanding of what constitutes as good performance in the task according to Deci, Koestner & Ryan (2001, 5).

In Brewer et al. (2013) study, introduction of points and rewards/prizes in the form of gamification were successful in motivating children to complete tasks (2013, 390), increasing task completion rates from 73% to 97% (2013, 388). Best rewards offer

utility or value in the game, though romantic associations (such as gold or magic weapons) or ties into the storyline can also improve the perceived value or impact of a reward (Fullerton et al., 2004, 275-276). Uncertain rewards release more dopamine than predictable ones according to Kapp (2012, 102).

Rewards should be used to motivate players to perform boring tasks, whereas feedback should be used in the case of interesting tasks according to Kapp (2012, 236). Schell (2008, 189-190) identifies nine common types of rewards in games; praise, points, prolonged play, gateways, spectacle, expression, powers, resources and completion. Praise tells you did a good job whereas points often serve no other purpose than to measure players success. Prolonged play allows player to play longer through extra lives or time. Gateways move player to a new part of the game such as granting access to a new level while spectacle is displays such as music or animation used as a reward mechanism. Expression grants objects such as clothes or decoration options for self-expression, powers grant the player character more power while resources are things like food, energy, ammunition, hit points or virtual currency required in the gameplay. Completion is a feeling of closure stemming from beating all the goals in a game. (Schell, 2008, 189-190).

Points and scoring manifest in different forms in the elements within this dynamic, such as leaderboards, virtual currency, experience points and exercise score/grading. Elements such as levels, progress bars, streaks and performance graphs that indicate the player's progression through the game often utilize points. Dicheva et al. (2015, 4) classify points, progression bars, levels and virtual goods/currency as progression elements. Achievements, trophies and badges are awarded to players for completing these tasks and goals in turn.

C2 – Virtual Currency

C2 – The game features a virtual form of currency

Synthetic currency (Read & Reeves, 2009, 126) or virtual currency (Nah et al., 2013, 104) is a form of currency used within the game. Based on Fu's (2011, 27) definition, points are a form of virtual currency. As mentioned earlier, offering players virtual currency instead of rewards for completing tasks gives players a greater sense of control according to Kapp (2012, 237), implying a connection to autonomy. As virtual currency

is inherently linked to virtual goods (Dicheva et al., 2015, 5-6), I could've included them both as an autonomy feature. I've separated the elements on the basis that as a form of point (Fu, 2011, 27), virtual currency is a reward (incentive) awarded to the player based on accomplishment (supporting competence), which then can be used to purchase virtual goods, wherein autonomy is supported through a sense of control and self-expression.

In some commercial and F2P games virtual currency can be bought with real money. For example, in *FrontierVille*, the player has two currencies, "coins" (easy to earn currency earned from most actions) and "horseshoes" (hard-earned currency sold for real money). With horseshoes, the player can bypass missions by purchasing an instant completion. (Tyni et al., 2011, 23). Considering the context of gamification of education, I define this element solely to currencies rewarded to the player by the game, as using money to bypass the learning process runs against the goals of gamifying education. This currency can take different forms, such as tokens or diamonds.

C3 – Experience Points

C3 – The game features experience points

Experience points are a measure of progression awarded to the player for completion of quests and overcoming obstacles (Kapp, 2012, 40-41). While they are generally linked to player level (R2), I've separated the elements to account for the potential situation that a game would include one without the other.

C4 – Score/Grade

C4 – The game grades the players performance

Bjork & Holopainen (2005, 93) define score as the numerical representation of the player's success in the game. Score can be used to "grade" the player performance, as Li et al. (2012, 104-108) did in their gamified tutorial system, rating the player's performance from 0 to 5 stars at the end of each level and presenting them a customized message based on their performance. Speed of completion and not using hint or undo (replay) features increased the score / number of stars earned per task (Li et al., 2012, 107-108). Although Li et al. (2012, 104) themselves categorized this feedback under the

element of "Rewards", Seaborn & Fels (2015, 22) categorized it as scoring, so I will consider it an example of scoring myself, and thus a manifestation of "Points".

I define this element as any system that grades the player's performance of a task, objective, mission or a level, whether through letters, numbers, stars or any other unit of measurement. The scoring system that Li et al. (2012) used could be modified based on the education context and goal, such as giving bonus modifiers to scores for not making mistakes or providing extra synonyms in a language game.

C5 – Levels

C5 – The game presents its tasks in a level-structure

Kapp (2012, 37-41) divides levels into three types: game levels, playing levels and player levels. Game levels can also be known as stages, area or world (Seaborn & Fels, 2015, 20). Levels are "*increasingly difficult environments*" (Seaborn & Fels, 2015, 20) and the part of the game in which all player actions take place until a certain goal or end condition has been reached (Bjork & Holopainen, 2005, 60). Moving from one level to another typically signifies a change from one location to another, so changing theme can be a way to differentiate levels (Bjork & Holopainen, 2005, 61). Levels can be used to support a smooth learning curve according to Bjork & Holopainen (2005, 61).

Per Seaborn & Fels' (2015) definition, I will limit levels in my definition to tangible game environments in which the game takes place in, which become progressively more challenging over time. In an educational context, tasks and exercises are thus framed and presented as visually concrete areas in the game world as levels. Beating the goal or goals of a level leads the player to unlock the next level which is harder, leading to scaffolding and ideally optimal challenge that develops alongside the players skill level. These levels are entered by using a level selection tool based on a game design pattern such as "Game State Overview" (Bjork & Holopainen, 2005, 61), which also allows the player to replay previous levels. Many educational games can use a level-like structure in presenting exercises or courses and allow players to make choices in which order to complete tasks (A6 – multiple routes to success), but if the gameplay doesn't take place in a concrete game environment, it doesn't match and fulfill this definition of the element.

C6 – Progress Bar

C6 – The game features progress bars

Progress bars are used to track and display the players progression graphically (Nah et al., 2014a, 406; Dicheva et al., 2015, 4). In an educational game, they are used to motivate players who are close to achieving their goal, or encourage them if they are falling behind in their progress (Nah et al., 2014a, 406). As mentioned earlier at A4, progress bars also provide clear goals, as well as feedback, according to Sailer et al. (2013, 35), so they could be placed under either of those categories as well, but Dicheva et al. (2015, 4) categorized progress bars under the design principles of progression as well.

By my definition, progress bar doesn't literally have to be a bar, it can be shaped like a circle for instance, as long as it tracks the players progress visually.

C7 – Score/Play streaks

C7 – The game features an incentive system based on streak goals

According to Adrup & Skogström (2016, 4), streaks are regular sequences, such as daily goals, that incentivize the player to play daily to grow and maintain a streak. If the goals are not achieved, the streak resets and the player has to start from the beginning again (Adrup & Skogström, 2016, 4).

I define this element as an incentive system that visually tracks player performance, used to incentivize consecutive actions. This can either manifest within a task as a score streak, or across play sessions as a play streak. A score streak grows upon consecutive correct answers and results in a reward such as score multiplier which increases score. A play streak tracks the player's daily/weekly involvement and yields a mechanical incentive to reach a certain goal on a set amount of consecutive daily play sessions. The goal could be to complete a new lesson every day, with an incentive such as virtual currency or a boost to the player characters performance. The reward can also grow higher the longer the streak is maintained.

C8 – Performance Graphs

C8 – The game allows players to visually track their performance development

Performance Graphs provide information about the players' personal performance over time, in contrast to leaderboards, which compare the players' performance to that of other players (Sailer et al., 2017, 373). They foster mastery orientation (Sailer et al., 2014, 35) which is particularly beneficial to learning (Nicholls, 1984 & Dweck, 1986, as cited by Sailer et al., 2017, 373). Performance Graphs affect competence need satisfaction positively (Sailer et al., 2017, 371).

I define this element as any feature that allows players to visually track their performance, regardless of whether the data is visualized using graphs or not. Unlike with streaks, there doesn't have to be a reward or incentive embedded in the application of this element.

C9 – Badges/Achievements

C9 – The game awards badges or achievements for accomplishments.

Badges are virtual representations of achievements (Sailer et al., 2013, 34). Achievements can be recognized in the form of badges (Nah et al., 2013, 101; Domínguez et al., 2013; Dicheva et al., 2015, 4) or other kudos systems such as trophies, ranks, stars or awards (Nah et al., 2013, 101). They can foster players feeling of competence and work as virtual status symbols according to Sailer et al. (2013, 34). Eleftheria et al. (2013, 4) propose using a freeplay mode to award players a chance to earn extra badges exclusive to the mode as an incentive to step outside the constraints of the structured game.

I define achievements and badges as visual icons rewarded for accomplishing tasks or performing optional challenges. These icons do not serve a gameplay function, so they are not virtual goods or character customization options. They might grant achievement points, but these points are not a form of currency that can be used to purchase virtual goods or unlock content. However, like player levels and ranks, these achievements could be used as a pre-requisite for access certain content. For example, the player might have to unlock the achievement for mastering the conversational basics of Spanish before they can unlock exercises focusing on traveling vocabulary.

C10 – Profile Page

C10 – The game features a profile page that tracks the players accomplishments

Similar to R4 (Friend list), this element accounts for a feature that tracks the players' achievements and badges. Aparicio et al. (2012, 2) identify "profiles" as a game element that supports autonomy, but do not provide a definition for the term. As I came across "profile pages" used to track achievements and performance during my formal analysis, I created this element to represent it and placed it in competence.

5.3.2. Risks and Challenges

The importance of optimal challenge in gamification (Whitton, 2009, 42-43; Harviainen & Meriläinen, 2019, 555), games (Sweetser & Wyeth, 2005, 5-6; Bjork & Holopainen, 2005, 392-393), playful learning (Fontijn & Hoonhout, 2007, 119-120) and obtaining the flow state (Csikszentmihalyi, 2014) is a point raised by multiple authors in the articles I referenced. Lack of challenge can bore players while too high difficulty can result in players giving up and quitting (Bjork & Holopainen, 2005, 392; Csikszentmihalyi, 2014, 135; Harviainen & Meriläinen, 2019, 555). Optimal challenge that matches players skill level supports competence (Aparicio et al., 2012, 2; Mühlhaus et al., 2017, 77) and creates engagement, possibly even flow (Csikszentmihalyi, 2014, 139-140; Hamari et al., 2016, 175-177). Flow and optimal challenge could even be seen as the same concept in a game context (Kapp, 2012, 71-72).

Progressive disclosure (Li et al., 2012, 105), integration (Klock et al., 2015, 597), adaption (Mühlhaus et al., 2017, 80), onboarding (Nah et al., 2013, 107; Dicheva et al., 2015, 5) and scaffolding (Kapp, 2012, 66-67; Nah et al., 2013, 107) are also terms used to refer the importance of optimal challenge progression in creating player engagement. Bjork & Holopainen (2005, 61) talked about smooth learning curves in the context of using level design in particular to provide an optimal progression for challenge. Curve of Interest describes the flow and sequence of events that a game uses to maintain player's interest in general (Kapp 2012, 45), such as in the context of the narrative (Nah et al., 2014a, 406). For that reason, I posit that Curve of Interest could be interpreted as application of the principle of optimal challenge to other areas of the game besides challenge.

While the element of risks and rewards in game design wasn't discussed in the gamification research I presented in chapter 4.2, it bridges the conceptual gap between rewards and challenge (Schell, 2008, 179-194), so I combined it with the challenge dynamic of Blohm & Leimeister (2013, 276) which includes the elements of time pressure, tasks and quests. It also offers a counterpoint to the concept of freedom to fail that I covered in the experimentation part of the autonomy category.

Risk/Reward mechanics link a chance of receiving a reward to a penalty if the player fails to acquire the reward (Bjork & Holopainen, 2005, 375-376). Interesting choices must have the potential for both advantageous and disadvantageous effects according to Bjork & Holopainen (2005, 375-376). Balancing risks and rewards is an important consideration in the design of computer games according to Williams et al. (2011, 1), who link it to player-centered design (2011, 15). The concept of risk and rewards can include the element of chance and randomness (Schell, 2008, 184), and it can be witnessed in real-life activities such as gambling, stock-market trading and sports (Williams et al., 2011, 2). Risk and rewards can provide a lot of additional entertainment value (Williams et al., 2011, 1), give the player a chance to make more exciting and meaningful choices (Schell, 2008, 181) and create more complex dilemmas for the player (Fullerton et al., 2004, 271-276). If a game has a static reward but no element of risk, there is no incentive for the player to improve according to a Gamasutra (2006) article on the role of risk and reward in game design. This results in a lack of challenge, making the game "unfun" according to the article (Gamasutra, 2006). Schell (2008, 181) also claims that in his experience, 80% of game prototypes that are not considered "fun" miss meaningful choices in the form of risks and rewards.

Creating a balanced system of rewards and punishments is a way of making the choices in a game much more interesting to the players according to Fullerton et al. (2004, 275-276). Schell (2008, 192) suggests that adding risks in the form of punishments or negative consequences can make success feel more fulfilling to the players, add excitement to the game and create endogenous value by making game resources (such as virtual currency) more valuable to the player through the risk of losing them. Schell (2008, 192-193) identifies eight common types of punishment; shaming, loss of points, shortened or terminated play, setbacks, removal of powers and resource depletion. Waste of time, waste of money and character damage are also identified as common risks (Gamasutra, 2006), the latter two of which could be categorized as different forms

of resource depletion. Costello & Edmonds (2007, 79) include “danger” as a category of playfulness, which they link to risk and chance.

While optimal challenge has been categorized as a competence supporting feature by other authors, the risk and reward mechanic hasn’t been directly correlated with it. I chose to group it with challenge dynamic however due to how the concepts relate to each other. The elements in this category will thus account for elements based on challenge and risks/rewards. Risks will be accounted for via elements that could either be directly interpreted as a form of penalty/punishment or used in the administration of a punishment or penalty, such as lives or health points in the context of losing them as a punishment for taking a risk and failing. This is an important distinction, as “losing points” could be a categorized as a penalty, while points by themselves a reward.

C11 – Lives

C11 – The game uses lives or attempts to regulate the play time

Losing a life or hit points are examples of the punishment types of shortened play and resource depletion identified by Schell (2008, 192-193). Bjork & Holopainen (2005, 97) define lives as the “number of chances a player has within a game session before it is terminated”, stating that loss of one is “usually associated with at least some negative effects in the game”. Threats and dangers to the player character can evoke a pleasurable thrill of danger in players and increase their attachment to the character according to Costello & Edmonds (2007, 80). It should be noted that punishment types of Schell (2008, 192-193) typically work in a hierarchy in video games. Player characters often have a set amount of health points, which are lost upon taking damage (resource depletion). Losing all hit points generally leads to losing a life (shortened play), which can lead to restarting a level or reverting back to a checkpoint (setback). Losing all lives in turn leads to a game over state (terminated play). (Schell, 2008, 192-193). Gaining an extra life as a reward in turn leads to prolonged play, one of the reward types identified by Schell (2008, 189).

I define lives as attempts that limit or regulate play time, which are indicated as a numeric value. This numeric value typically represents the player characters life and is indicated visually by a symbol, such as hearts. For the sake of simplicity, I will only use this element to account for risk and reward mechanics. Like stated before, there’s a distinction between game elements such as virtual currency or points and losing them as a penalty for taking risks. Lives as a game element inherently indicate an element of risk, so they are thus

easier to categorize as a risk and reward-based element. Health points could also be included as a separate element in this category, as a player might have infinite attempts to beat a goal such as a level, but a limited amount of health points to do so, requiring the player to start over upon losing all health points.

C12 – Playing/Difficulty levels

C12 – The game features multiple difficulty levels to choose from

Curve of Interest, and even optimal challenge, are hard to measure. Perhaps optimal challenge could be measured with how adaptable the game content is to the player's specifications. In the case of educational games, this could mean creating a study plan based on the user's needs and adapting the content to it. But optimal challenge could also entail using game design techniques such as rubber-banding, a term used to describe how NPCs adapt their speed to the player's performance in some racing games (Mark, 2010). Measuring whether a game involves such measures or not would require playing the same game on multiple different accounts/users and devices, which is too time intensive for this study. As solutions like that are highly dependent on the content of the game, I will simply use difficulty levels/playing levels to account for the concept/element of optimal challenge.

Kapp (2012, 37-41) divides levels into three types of levels: game levels, playing levels and player levels. Playing levels account for having multiple different difficulty levels in a game, with differing levels of interaction and guidance according to Kapp (2012, 39-40). Higher difficulties catered to more experienced players can for example entail more challenging puzzles, enemies that move faster or having less time to complete tasks (Kapp, 2012, 39-40). I define this element as the option of having multiple difficulty levels to choose from. Different age brackets in the context of an educational game are not considered difficulty levels by this definition.

C13 – Time-pressure

C13 – The game features goals and tasks that have a time limit

Time is an element that relates to game design in many ways (Kapp, 2012, 32). Clocks, timers and countdowns can create a sense of urgency and compel the player to action (Read & Reeves, 2009, 88; Kapp, 2012, 32), time can be a resource allocated during gameplay (Kapp, 2012, 33) and it can be compressed to illustrate the consequences of

actions more quickly than in real life (Kapp, 2012, 33). Timing is an essential element in gameplay actions and genres such as platforming, fighting games and aiming & shooting (Bjork & Holopainen, 2005, 362-363), and many specific game mechanics such as spell durations are dependent on time management (Read & Reeves, 2009, 88). As Blohm & Leimeister's (2013, 276) challenge dynamic included time-pressure as an element, I've grouped this element in this category.

This element accounts for if the game features tasks or challenges that impose a time limit on the player. As Bjork & Holopainen (2005, 357) categorize timing as an element relating to game mastery, more elements based on timing could be included, such as rhythm-based actions (2005, 363), which require the player to time multiple actions in a row correctly. Bjork & Holopainen (2005, 362) define timing as the "effect on gameplay that actions have to be performed at certain points in game time to be performed at all" or that the direct effects of actions vary greatly "depending on when they are performed". Game mastery in turn corresponds to the principle that one should clearly be able to distinguish gameplay between skillful and incompetent players according to Bjork & Holopainen (2005, 364-365), and that proving how skilled they are can be a significant reason to play for players (2005, 357). I posit that this corresponds with competence need satisfaction.

C14 – Quests/Optional challenges

C14 – The game features optional challenges

Quests are tasks which offer a reward upon completion (Lewis et al., 2012, 176; Sailer et al., 2013, 35). They provide clear goals (Sailer et al., 2013, 35), progress feedback based on the goal-gradient hypothesis and means to train the player to perform progressively more complex tasks (Lewis et al., 2012, 176), providing an opportunity for scaffolding. The creation of flow experiences sometimes necessitates unpleasant pressure in the form of challenges (Korhonen et al., 2009, 278).

While these definitions do not take in to account whether or not these quests are optional or not, I choose to limit my definition to optional tasks which provide extra challenge for the player. This way the element contrasts to the mandatory content that all players must complete. A quest or task could be an optional separate challenge, or an additional challenge within a level or task whose completion is not mandatory.While on

that basis, you could make the argument that the element should be categorized in autonomy, quests and tasks are designated to the challenge dynamic by Blohm & Leimeister's (2013, 276). Quests could also relate to storytelling, if they provide a narrative context for the action.

5.3.3. Audiovisual feedback and Reinforcement

It's been claimed that positive (Aparicio et al., 2012, 2) or adequate (Mühlhaus et al., 2017, 77) feedback supports competence. Feedback is a form of reinforcement according Nah et al. (2013, 103) while Klock et al. (2015, 597) categorise feedback and reinforcement together. One of the most enduring principles of psychology according to Read & Reeves (2009, 71) is that feedback changes behavior. Feedback can also be negative (Read & Reeves, 2009, 71-72), which can offer corrective information (Nah et al., 2013, 101). The higher frequency and intensity of feedback is one of the strengths games possess over traditional learning environments according to Kapp (2012, 35). Games are more intrinsically motivating when the feedback they provide is frequent, clear, constructive and encouraging according to Malone & Lepper (1987, 232). Immediate feedback is a necessary component of gamification (Nah et al., 2013, 103), and linked to attaining the flow state (Nah et al., 2014b, 83-88). In a state of flow, you always know how well you are performing (Csikszentmihalyi, 2014, 135).

Feedback can reinforce performance (Nah et al., 2013, 103), which can happen without directly telling the player whether they are right or wrong according to Kapp (2012, 36). For example, sounds can be used as a form of feedback to guide the player, responding to the players actions and highlighting their consequences (Kapp, 2012, 36). Feedback in games comes in different forms, such as text, visual and auditory, supporting different senses (Read & Reeves, 2009, 74). It can be informative, emotional or fulfilling (Whitton, 2009, 48).

Points, levels and elements that display the players progress are a form of feedback according to Nah et al. (2013, 103), while Sailer et al. (2013, 35) defines progress bars and performance graphics as feedback. Read & Reeves (2009, 72) note that feedback in games happens both on a long and short-term scale. Progression elements would fall in the category of long-term feedback. However, I chose to create the separate progression category for those elements, so I will focus on short-term feedback in this section.

Kapp (2012, 36) ties feedback to juicy design, so elements relating to game feel and pleasing sensation of control could be used to extend this category based on my argumentation in Chapter 3.4. I explained in the previous section that I chose to present elements corresponding to the concept of aesthetics in this chapter, as according to Schell (2008, 42), aesthetics do not just relate to how a game looks, but also how it sounds and feels. The sensation of aesthetically appealing control is one of the factors that contribute to good game feel according to Swink (2008, 287), along with instantaneous response and predictable results, which correspond to clear and immediate feedback. Intuitiveness (Mühlhaus et al., 2017, 77) and intuitive controls (Aparicio et al., 2012, 2) in turn have been suggested as elements that support competence. Elements relating to fluid, responsive and satisfying controls could expand this category, but as none of the games in my formal analysis featured directly controllable avatars, such elements will not be included in this framework. I posit that inclusion of such characters and application of game feel design principles to their control could provide a potential avenue for improving gamification.

C15 – Clues

C15 – The game contains clues or tips

Clues are game elements that give players information about how to reach the game's goal, either explicitly, or through more subtle means, such as incorporating directions in to the level design and environments (Bjork & Holopainen, 2005, 90). Clues provide feedback and can take the form of advice, encouragement or warning according to Bjork & Holopainen (2005, 90).

I define this element as any kind of clue or tip given to the player outside of task instructions and quests, such as loading screen tips.

C16 – Compliments

C16 – The game provides reinforcement through written or verbal compliments

According to Nah et al. (2013, 101), the behavioural learning model purports that learning takes place through reinforcement, such as verbal praises or compliments. Verbal compliments are likely to enhance perceived competence and thus enhance intrinsic motivation according to Deci, Koestner & Ryan (2001, 3). Praise is a form of reward that tells the player they did a good job, either through an explicit textual or

verbal statement or a sound effect (Schell, 2008, 189). Feedback such as praise can be given to the player by NPCs (Whitton, 2009, 48).

I define this element as any text-based or verbal compliment that praise the player upon completing a task. However, unlike Schell (2008), I do not categorize this element as a reward.

C17 – Sound Effects

C17 – The game provides reinforcement through sound effects

Continuation of the last element, this element covers auditory feedback based on sound effects rather than spoken/written compliments. Sounds can be used to enhance presentation of learning material as well as increase user engagement in virtual environments according to Nah et al. (2013, 104). Audio feedback is more visceral than visual feedback and simulates touch more easily according to Schell (2008, 351).

C18 – Voice Acting

C18 – The game contains voice-acting

This element accounts for whether the game includes voice acting or not. I considered dividing the compliment element into textual and verbal compliments, however the element of voice acting is more extensive, as it covers all voice acting and not just compliments. I posit that voice acted characters could potentially enhance identification. I could not find any research on the matter, but voice acting has been used in gamification to stimulate motivation by aligning game characters communication more closely with that of the players (Gay et al., 2016, 124). My definition of this element excludes oral instructions in language education, if it is the sole form of voice acting within the game.

C19 - Music/Soundscape

C19 – The game features music and/or a soundscape

The majority of the research on gamification and game design that I've refenced here does not cover the elements of music and sound to meaningful extent. Schell (2008, 351-352) encourages the use of audio and music in game design however, stating that

one serious error that game developers often fall into is not adding music or sound to their game until the very end. Only Li et al. (2012, 108) included sound effects and background music in gamification and acknowledge and categorized them as stimuli. There's a noticeable difference in the level of auditory feedback and stimulation when comparing the educational games of my formal analysis with commercial video games. For that reason, I've added this category to account for whether the game includes music and/or a soundscape. I define soundscape as all the background sound effects that seek to simulate effects and environments, such as the addition of rain sounds if the game world is rainy. These sounds contrast to sound effects that are used as a form of reinforcement when answering a question correctly or completing a task.

C20 – Animated Feedback

C20 – The game provides reinforcement through animations

This element accounts for visual reinforcement methods in the form of animations, such as displaying a shower of confetti and floating balloons upon completion of a task. Loading screen animations and progress bars that fill up are not counted as animated reinforcement by this definition, but rather classified as clues and progress bars respectively.

C21 – Animated Avatar

C21 – The player character or avatar is animated

This element accounts for whether or not the player character/avatar is visualized and animated within the game world. An animated avatar performs tasks, moves within the game world and engages in different tasks. They can either be directly controlled by the player or respond to their commands indirectly, by moving forward when the player character answers a math puzzle correctly for example.

As some definitions designate avatars as characters that the player exerts control over (Read & Reeves, 2009, 64), being the conduit for interacting with the game world (Bjork & Holopainen, 2005, 78), you could create a separate element for avatars/player characters that the player can directly control by making them physically move in the game world and perform actions such as jumping and shooting.

5.4. Considerations

The framework, list of elements and their definitions that I present in this chapter were tested and approved by Education Alliance Finland, addressing issue E of formal analysis explained in Chapter 4.1. Proof of this validation process is included in the attachments of this thesis. That being said, this chapter presents some caveats and considerations regarding its formulation and future potential.

While this thesis utilizes Deterding et al. (2011) definition of gamification which excludes elements of playfulness, Costello & Edmonds (2007) categories of playfulness were utilized in two elements (R6, R7) and one dynamic (Self-Expression and Creation). I argue that in the context of my formal analysis, this conflict doesn't violate this definition of gamification, as I could identify these elements within gamified applications that meet the criteria of this definition.

The list of identified elements was shaped by this formal analysis, so whether there are enough of sources to meet the criteria D of formal analysis identified in chapter 4.1 could be questioned in case of many different elements. For example, Adrup & Skogström (2016) is a bachelor's thesis. However, it is the only gamification article that used streaks as a game element, which I identified multiple times during my formal analysis. Similarly, Bunchball (2010) is a white paper. The research and data I employ might not always be universally applicable either. For example, the three primary motivations for playing digital games identified by Whitton's (2009, 38-39) study, which I reference in this work, are not necessarily applicable to people who do not play games in their leisure time, as the study was conducted amongst people who consider themselves gamers.

While I use dynamics to categorize and combine elements and sources in a more congruent way, some of the elements of my framework arguably are not clearly enough defined to support this categorization. For example, the elements relating to exploration and aesthetics that I present in Chapters 5.1.1 and 5.2.2 respectively are not strictly and conclusively elements or mechanics the same way as leaderboards and progress meters are. Despite the attempt to make a clear division between conceptual and practical design patterns, conceptual murkiness still exists in some of my elements. This is not unique to my work, as similar gray areas could be witnessed in earlier frameworks discussed in this thesis. That being said, this framework should thus be treated as a prototype.

The inclusion and implementation of SDT could also be called into question. The validity of certain assertions, like elements of narrative, fantasy, simulation and aesthetics being designated to relatedness, could be called into question, and whether or not moving elements from one category to another bears any consequences raises the more fundamental question of whether there is any merit to the system as a whole. SDT is a popular theory in gamification and prior research has used mapped game elements to its different components (Aparicio et al., 2012; Mühlhaus et al., 2017; Sailer et al., 2017), supporting its inclusion in my framework. Addressing these components in gamification design should help foster autonomous motivation in players according to Proux et al. (2017, 92), so the SDT component of my framework can provide utility at least in providing a checklist to ensure that the game features elements supporting all three components.

The issue with this model is that the three components are very broad, and as demonstrated by this chapter, they can often overlap. Literary sources, when they could be found in the first place, often contradict each other in how to classify specific elements and mechanics like avatars, so my categorization could be argued to be arbitrary in some cases. This might not be a bad thing, however. If an element fails to comply neatly with a fairly binary classification system, this pluralistic value could imply that it is especially significant to players, if it can elicit different kinds of emotions and motivations simultaneously. You can witness this phenomenon in some of the classification systems showcased in the literature that I reference in this chapter. For example, all of the game design elements that Nah et al. (2014b, 110) mapped to flow components correspond to multiple different components simultaneously. My placement of elements was based on strongest perceived correlation rather than exclusive correspondence with their respective SDT components.

The framework could still be expanded upon in future by creating a more refined classification system for its motivational component. For example, the psychological need of stimulation used by Hassenzahl et al. (2013, 22) could complement the SDT framework, providing overlap with the competence category. Randomness, which Bjork & Holopainen (2005, 373-374) identified as a game design pattern, might be central to stimulation experiences according to Hassenzahl et al. (2010, 361). It is also an important ingredient in maintaining motivation in contexts such as gambling, roleplaying games and simulations (Malone & Lepper, 1987, 232). Educational games are often purely skill

based, so chance components usually are not present in their design (Harviainen et al., 2014, 67). The right level of uncertainty to introduce motivation in games of chance is 50% according to Kapp (2012, 102). PLEX, or Costello & Edmonds' (2007) categories of playfulness such as sensation and subversion could provide dynamics for the stimulation category.

Sensation is the pleasure players get from the feeling of physical actions the game evokes, such as touch, body movements, hearing and vocalising (Costello & Edmonds, 2007, 81). Movement-based digital games are increasingly popular (Mueller & Isbister, 2014, 2191), so motion controls are an example of an element that could be included within this category. The kinaesthetic simulation provided by good game feel could also be included under the sensation dynamic. The feedback dynamic within competence could thus transition to this dynamic. Some of the elements within my feedback dynamic, such as C19 and C20, could certainly be viewed as stimulation supporting features, as Li et al. (2012, 108) talked about sound effects and background music in terms of stimulus in gamification.

As for subversion, the pleasure of breaking rules (Costello & Edmonds, 2007, 81), Read & Reeves (2009, 80) note that rules allow games to work, but discovery and experimentation within the boundary of those rules can be part of the fun for players. Players violating the teacher's or designer's intent by exploring the limitations of a game system could be beneficial, or "functional bad play" according to Harviainen et al. (2014, 64). Transgressive play, performing unintended gameplay actions by breaking rules (Aarseth, 2007, 131-132), could be used as an element that ties stimulation back to autonomy by linking the subversion and exploration dynamics, as Espen Aarseth (2007, 132-133) describes transgressive play as a way for the player to regain their sense of identity and regain control under the rule structure of a game system.

While the components' and elements' relation to one another is likely more nuanced and complex in reality, a four-component model supplementing SDT with stimulation could present these categories as a circular continuum which loops back to its starting point in the end. I present a potential format for such a framework in Chapter 7.3. I posit that the value of such a framework is based more on providing a tool for conceptualizing design than providing immaculate and irrefutable categorizations.

6 RESULTS

In this chapter, I will conduct formal analysis by studying 10 educational games and gamified apps, which I will refer to as "games" for the sake of simplicity, as a case study of contemporary gamification design. As gamification in an education context can be characterized as the use and application of game elements (Pechenkina et al., 2017, 2), this formal analysis focuses on identifying game elements. To address the research issues A and C of formal analysis presented in Chapter 4.1, I will provide descriptions of the games I studied in the Chapter 6.1. I will then map the results to my framework in Chapter 6.2 and dedicate rest of the work to discuss the results, limitations and findings of this case study.

6.1. Formal analysis

I chose to study ten different games for my formal analysis. I decided to cover ten games representing five different categories in order to showcase different applications of gamification and allow for comparison within the different fields, while still retaining a manageable scope. The five different pedagogic categories covered by these games are language, programming, math, music and "general". Games in the general category apply gamification techniques to teach or motivate the user in more than subject or aspect of their lives.

For the sake of convenience and my lack of prior experience with educational games, I chose these games from a list of suggestions provided to me by Education Alliance Finland. I did include one game (Elevate) that wasn't included in this list of suggestions, because I had to find a second game from the "general" category. I had total creative control in this process, so I had no obligation to include any specific game or game type in this analysis. While most of these games are mobile games, I also included browser games played on a desktop computer in the analysis. Trial or free version of the game was utilized in all but one of the evaluations.

6.1.1. Language

Games in this category focus on teaching a language. I chose mobile games Duolingo and Busuu to represent this category. Duolingo is the most popular game in this category, as it has over 300 million users (Smale, 2020). Busuu boasts a smaller userbase of 90 million (Kennedy, 2019) but has been claimed to be better than Duolingo for learning the intricacies of a language in comparisons of language learning apps (Ekstein, 2017).

Duolingo is structured into sets of exercises. After an intro stage, players can choose a category of vocabulary such as traveling or restaurant to learn related words and phrases (A6). In these stages, new vocabulary and grammar is introduced over time. The player is asked to form sentences from a set of words, translate words and sentences, combine the right word to the correct alternative and to speak and pronounce words as well (A5). The exercises use simplistic cartoon illustrations (R6) to visualize words and concepts. Right answers elicit sound effects (C17) and fill up a progress bar (C6) which changes color as the player accumulates correct answers. Streaks of five or ten consecutive correct answers (C7) prompt motivational pop up messages from the game (C16). Completion of a stage results in a different sound effect and seeing your experience bar fill up, which grants experience points (C3) and levels up the player (R2). The player is also rewarded with lingots and crowns (C2), which can be used to buy power ups (A8) and outfits (A7, A9) for Duo. Duo is the owl mascot (R8) of the game who provides loading screen tips (C15). The power ups let the player perform actions such as freeze a streak, or double or nothing a wager by maintaining a seven-day streak as a gambling/risk & reward mechanic.

The profile page (C10) tracks the players' personal achievements (C9) and weekly streak (C7), provides a friend list (R4) which showcases friends achievements, league (R3) and performance (C8). The friend feature incentivizes the player to invite friends to the game for lingot rewards (R1), but also encourages competition by comparing players progress to that of their friends. Competition is also encouraged via a leaderboard (C1) and the corresponding ranking system

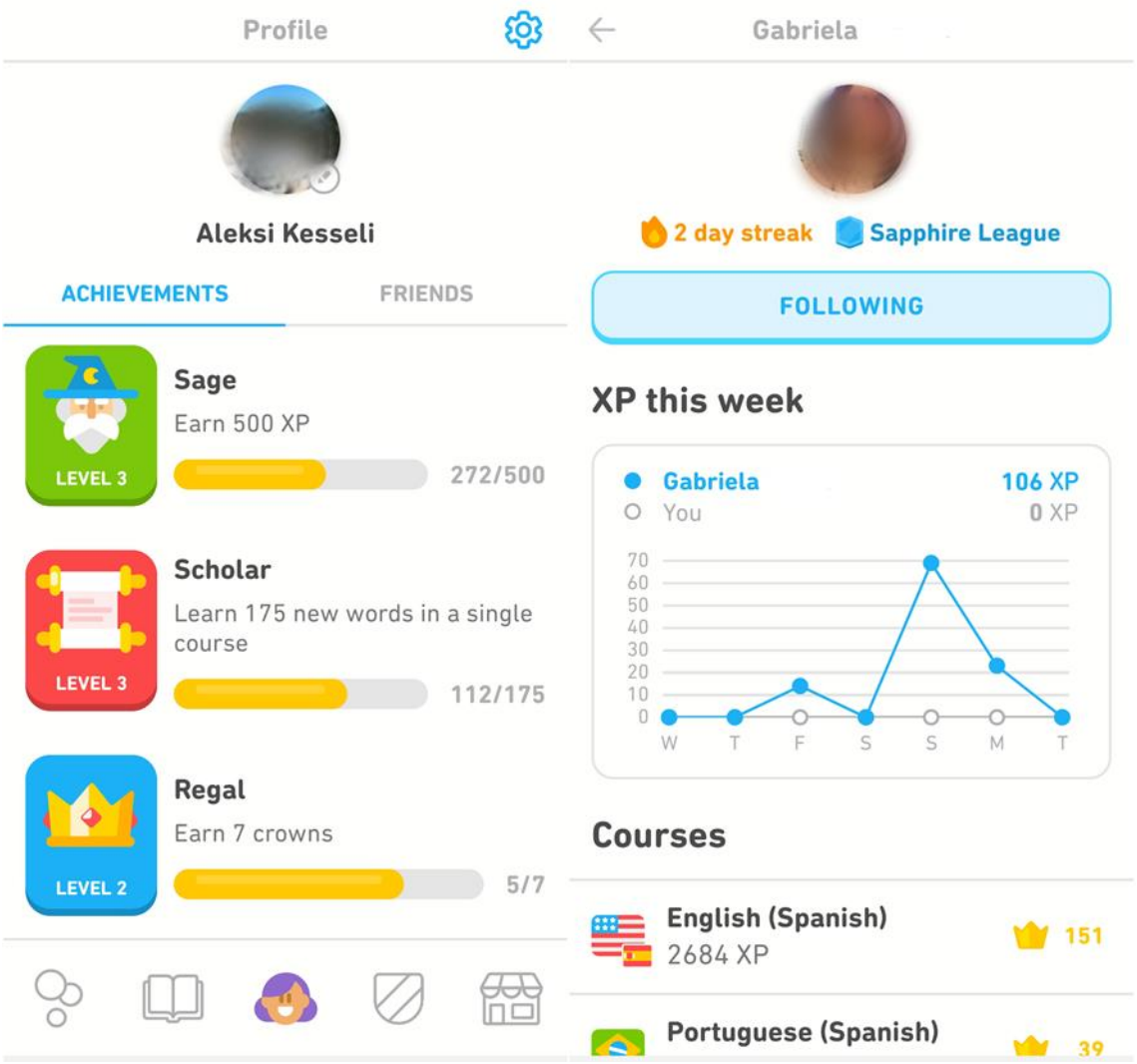

Figure 2. Duolingo

Figure 2 showcases the profile page and friend list feature of Duolingo. Multiple different elements can be observed in the figure: badges/achievements (C9), progress bar (C6), experience points (C3) and performance graphs (C8). The game also uses the player's Facebook profile picture as their avatar, though this doesn't match the definition of avatar I am using in this analysis. The last name of Gabriela has been censored to protect her identity. I will censor all last names from this point forward.

Busuu differs from Duolingo in its representation. While the user interface and structure are very similar, the game uses photos and real-life imagery (R6) instead of illustrated 2D graphics. The game looks and feels like it has been aimed to an older target audience. It also generates a study plan based on the user's needs.

Busuu is structured into numbered lessons (A6) which act in a similar manner as the stages in Duolingo. The goal is to translate, write and pronounce words and sentences

correctly (A5). Stages are divided into phases, with completion of each phase prompting motivational messages (C16) and a confetti animation (C20). Completion of a lesson results in a sound effect (C17) and an animation of a progress circle (C6) filling up. Weekly streak (C7) as well as learned words and progress (C8) are tracked as well.

There's a separate page (C10) for tracking your vocabulary and progress on individual words. The game also features a social page with a friendlist (R4). You can collaborate (R12) with other players by reviewing their exercises and in turn get yours graded by native speakers. This is the main differentiating feature between Busuu and Duolingo.

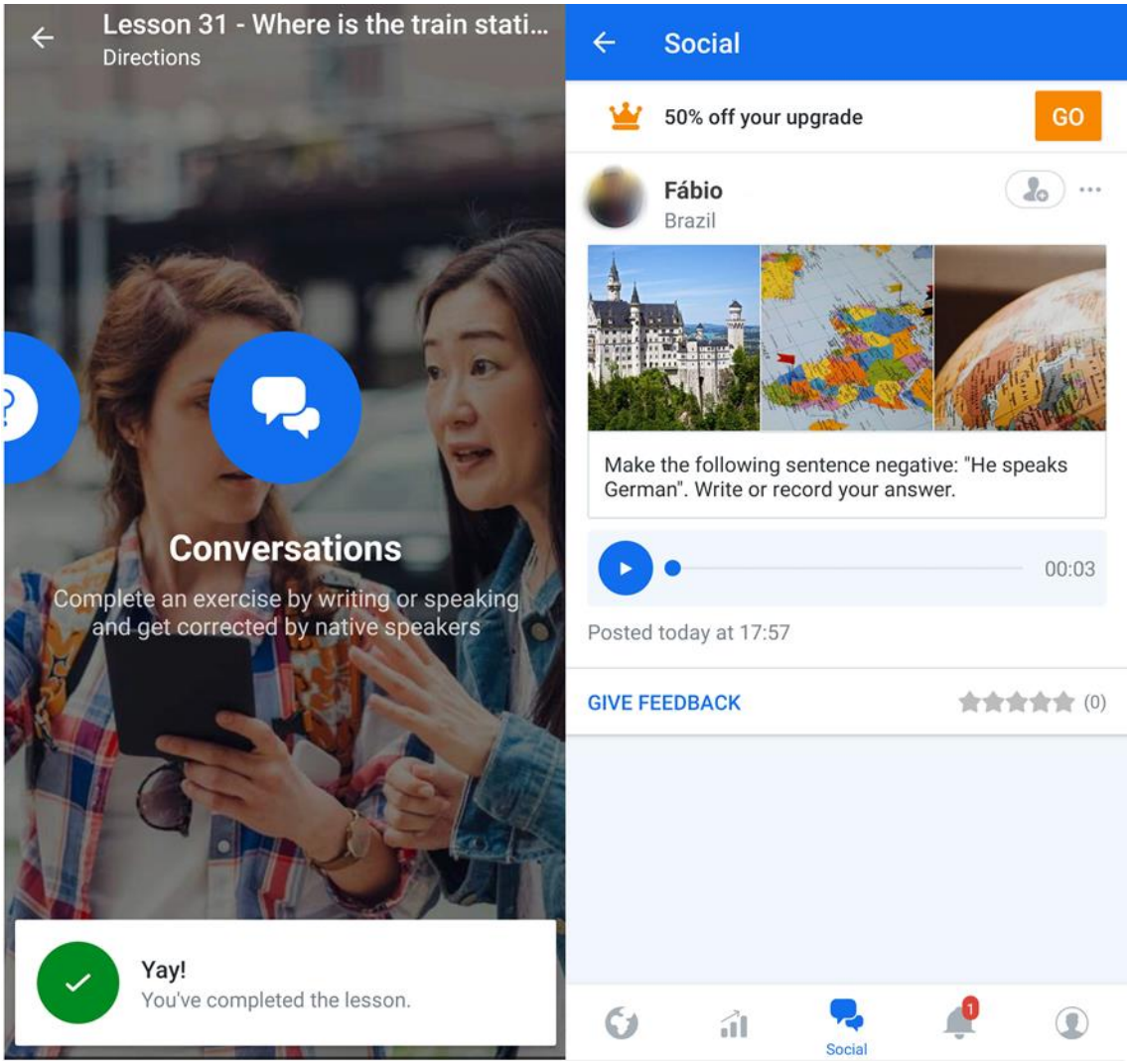

Figure 3. Busuu

Figure 3 showcases the user interface of Busuu and the feedback feature. Elements such as simulation aesthetics (R6), compliments (C16), collaborative actions (R12) and score/grade (C4) can be witnessed. However, as I defined C4 as scoring system built in the game, I do not count peer-reviewing this instance as it.

Both games have a similar structure and use roughly the same features. Duolingo features more profile investment features (in-game currency, customization, player level and achievements), whereas Busuu has a collaborative/social aspect to it that Duolingo doesn't. Busuu also includes a feature that creates a customized study plan to match the players' individual needs and skill level.

6.1.2. Programming

I chose Code Monkey and Coding Galaxy, winners of the best coding & computational thinking solution SIIA CODie Award in 2018 (Dayan, 2018) and 2019 (edu.nd, n.d) respectively, to present programming games. I played the browser version of Code Monkey and mobile version of Coding Galaxy.

Coding Galaxy teaches algorithmic thinking. The player is tasked with writing code inputs which makes the avatar (A12) perform actions (C21) such as turn left or right, jump and move forward. A rewind button (A3) lets players experiment by showing the results and potential flaws of their code without risks or commitment. A robot character named Codi (R8) instructs the player and explains the goal of each level (A5). Levels (C5) become progressively harder by incorporating new elements such as cracked tiles which can only be stepped on once. Optional challenges (C14) such as making detours to collect crystals and beating the stage under a set amount of moves improves how the player is graded when completing the stage (C4). While collecting the crystals can be optional, they are tracked by a progress bar (C6).

Figure 4. Coding Galaxy

Figure 4 showcases gameplay of Coding Galaxy. The commands the player writes control the movement (C21) of the avatar (A12). Pressing the run button executes the command (C20), while the rewind button in the lower left corner corresponds to the replay (A3) element. Compared to games in the language category, Coding Galaxy offers more control to the player. Beyond executing movement algorithms, the player can control and manipulate the camera angle. The production values are also noticeably higher, providing music (C19) and audiovisual feedback (C17) to support the space/sci-fi theme (R7).

Figure 5. Coding Galaxy

Figure 5 showcases how the character (R8) instructs the player (A5). Narrative context could also apply in a similar situation, where the instructions and goal are given a narrative purpose.

In Code Monkey you choose an avatar from a set of human and animal characters (A12) to represent you (see: Figure 6). Regardless of your choice, the player character in the game is a monkey, as the title suggests. You control the monkey by writing code (C21) to make him perform tasks like turn left or right and walk forward. The goal of each level, given to the player (A5) by another monkey character (R8), is to get to a banana. There is an option to hear the instructions instead of reading them, but as this feature uses a text to voice software instead of a human voice actor, I did not count it as voice acting/C18. Upon starting a level, there is also a cutscene (R10), though mine would not play for some reason. Nature sounds (C19), such as chirping birds, also add to the soundscape and complements the visuals (R6).

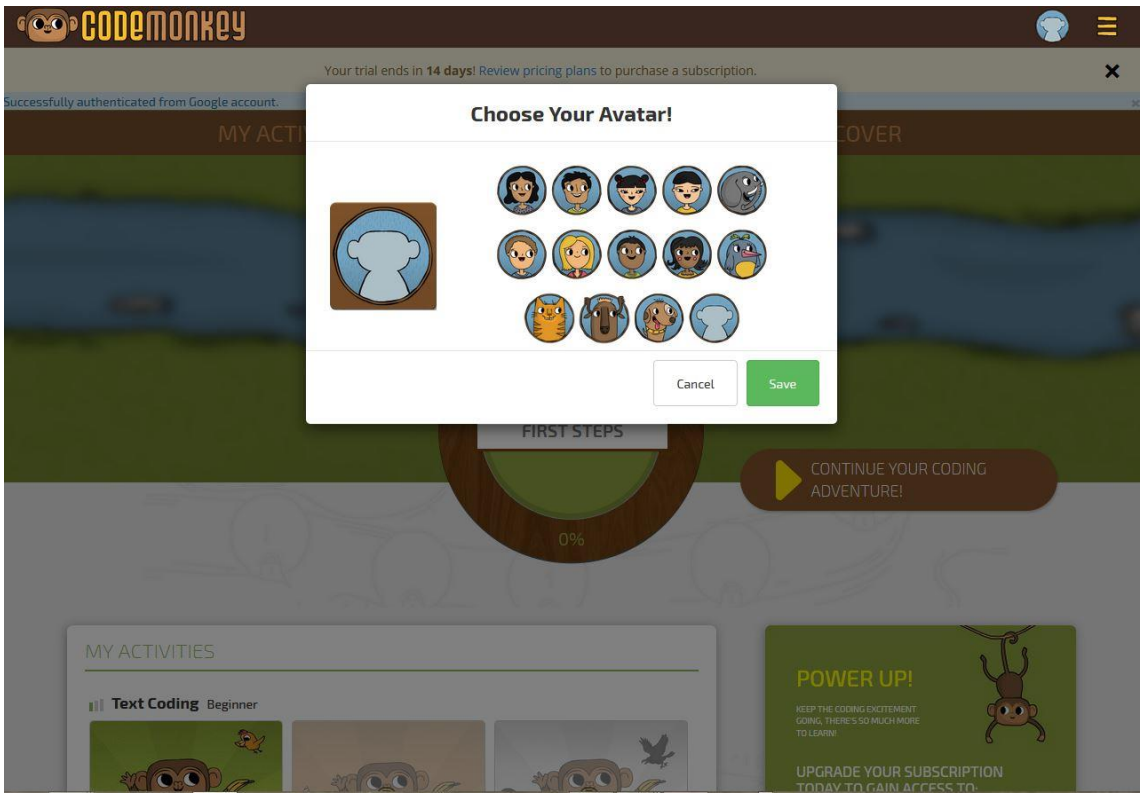

Figure 6. Code Monkey

Reaching the goal requires spatial thinking and calculating the correct amount of steps. There is a reset button (A3) to reset all the changes made to the code and start again from the beginning. Harder levels (C5) add new elements to the environment, such as a river that forces player to cross a bridge to get to the other side. Completing a level results in a short jingle (C19), sound effect (C17) and receiving a compliment from the instructor monkey (C16). Players performance is also scored on a scale of one to three stars (C4). Achievements (C9) are awarded by scoring three stars from all levels of a course.

Figure 7. Code Monkey

A course consists of 10 levels. The home page features a circle that shows how much the player has completed of the course as a percentage, which fills up to reflect progress (C6). Completing the intro course unlocks harder courses, allowing the player to choose from different options such as block coding, python or STEM (A6) in which ever order they want to complete the courses. These courses feature new characters and gameplay objectives, such as ensuring that a vehicle can cross from one end of the level to another by filling gaps and pitfalls with objectives. These objectives sometimes have a narrative context (R9), such as building a path to deliver bananas to feed a baby monkey.

While Code Monkey functions in a similar way as Coding Galaxy, it does differentiate itself by providing a game and challenge builder modes, where players can freely (A2) create (A11) games (A4) and challenges (C14) which they can share with other players. You can also play and discover other players' creations, where you can control the avatar directly with the arrow keys instead of inputting code commands (A20, A21). Players also have more control and freedom to experiment within the structured tasks of Code Monkey, as you manually write the values in to the code inputs. It should be noted however that I played the 14-day trial version of each game, so I could not access all of their features. Coding Galaxy does feature elements that Code Monkey doesn't offer, such as Augmented Reality support and ability to print a certificate upon completing the

introductory course. While the STEM courses of Code Monkey focus on teaching math, I decided to classify it purely as a programming game, and thus did not cover its STEM content in this analysis.

6.1.3. Math

I chose Zapzapmath and Mathseeds to represent this category. Zapzapmath is an educational math game designed by teachers (zapzapmath, n.d). Mathseeds was also developed by educational experts, it is compatible with the UK curriculum and boasts a 98% recommendation rating in a survey of 1030 teachers according to its creators (mathseeds, n.d). I played the free/trial version of Zapzapmath and full version of Mathseeds on a browser. I was provided access to an account with a valid subscription to Mathseeds by Education Alliance Finland.

Zapzap has a space theme (R7), so the intro and loading screens feature animations of flying spaceships and meteors, and the player character is chosen (A12) from a list of alien characters. You can customize (A9) the alien with new clothes (A8), purchased with coins (C2) rewarded for completing tasks. These coins can also be used to buy decorations and unlock new rooms (A7) in the players personal spaceship (A10) that acts as the avatars home. The spaceship (see Figure 8) corresponds to the element of player housing.

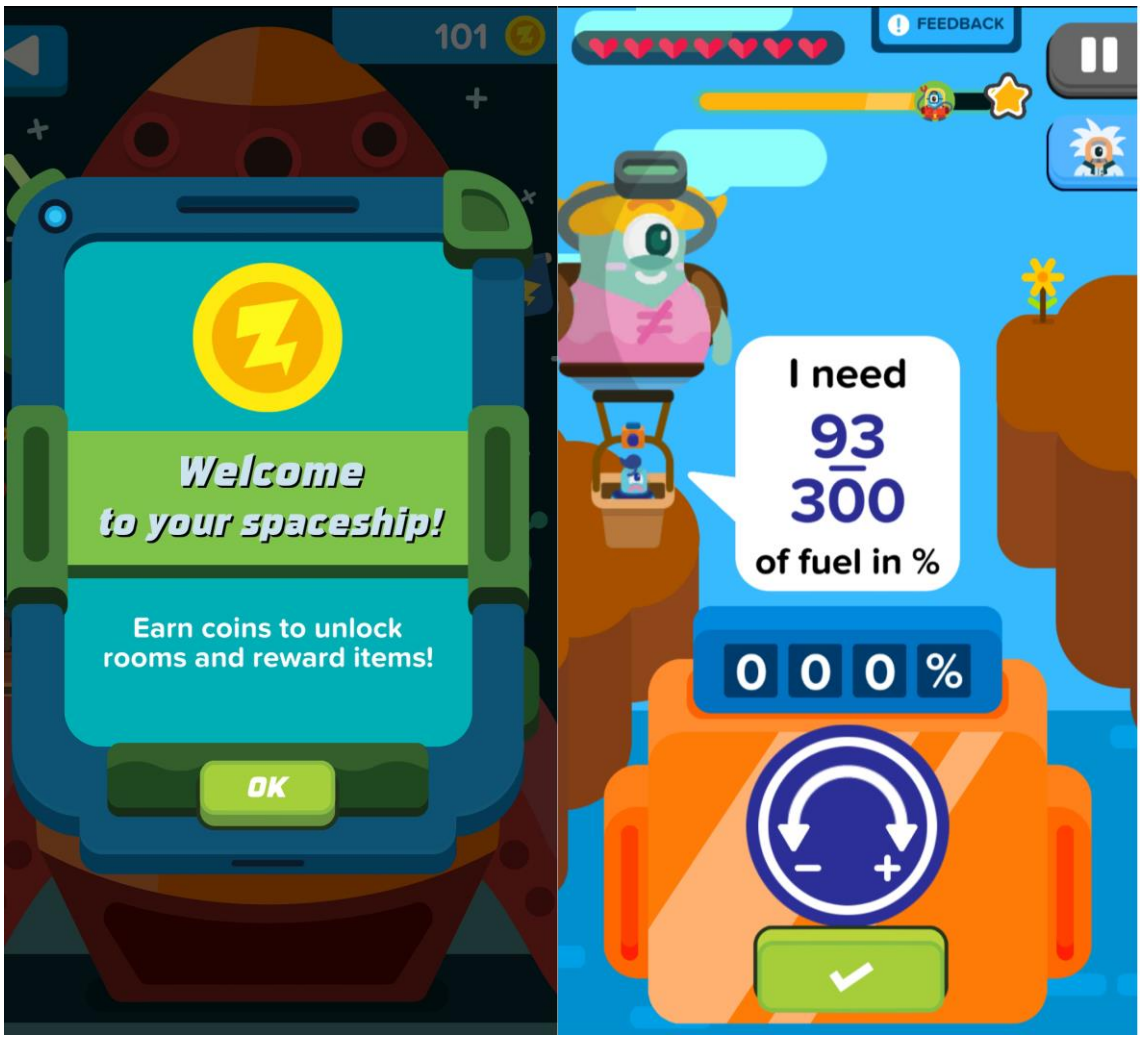

Figure 8. Zapzapmath

Levels (C5) revolve around math-based goals (A5), such as calculating correct amount of fuel for a hot air balloon of an alien who needs to cross a chasm (R9). A tutorial video with voice acted instructions (C18) is also provided at the start of the level. Motion controls are used to perform certain actions, such as calibrating the right amount of fuel by spinning a wheel. A wrong answer or miscalculation results in the alien falling in the chasm or flying too high (C21), accompanied by a gasping sound effect (C17) and a red flash in the screen (C20). Each failed attempt results in the player losing a life (C11), which are represented as hearts in the upper part of the user interface alongside a progress bar (C6) in Figure 9. Losing all lives results in a game over and having to replay the level. Correct answers on the other hand reward extra lives and result in a sound effect and a text compliment such as “superb!” or “awesome!” (C16) as well as the character icon moving closer to the goal in the progress bar. A score (C4) and performance graph (C8) accompanied by music (C19) and sound effects of filling scores and meters provide

feedback after completing a level. The player can also choose from multiple different levels which to attempt next (A6).

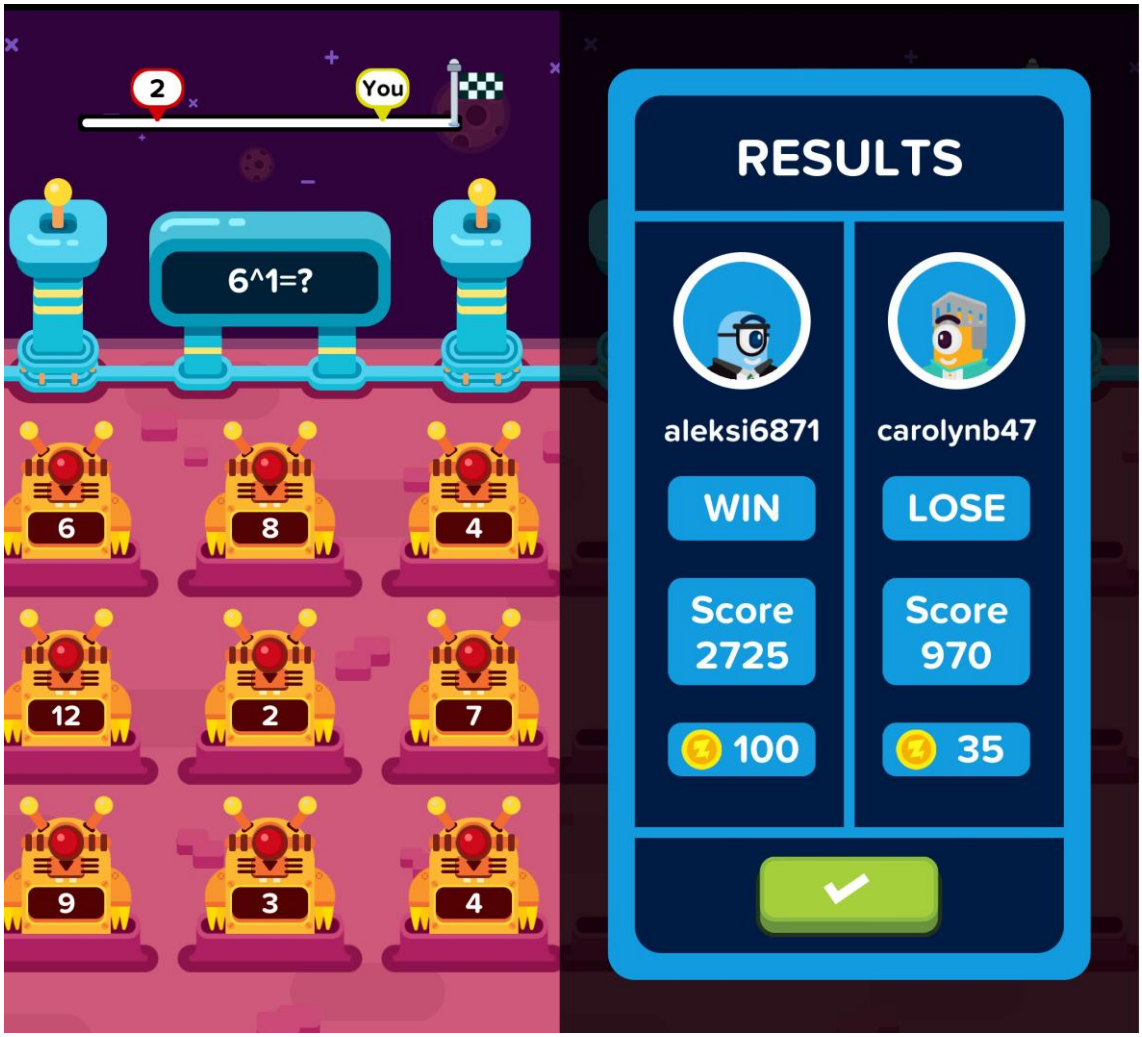

Figure 9. Zapzapmath

The game also allows for real time competition between two players (R14), as shown in Figure 9. Players wishing to compete will be paired up with another player by the game and then tasked to solve math problems. The player who reaches a certain number of correct answers faster wins the game. There's a progress bar in the upper corner showing both players' progress and how far they are from the goal. The winner receives more coins than the loser, but both players are rewarded in the end. Competing repeatedly will amass your score, and the 10 players with the highest scores in the world are showcased in a leaderboard (C1).

Mathseeds has a cartoony aesthetic that is grounded more so in every-day setting (R6). It uses a lot of animated cutscenes (R10) with cartoon animal characters (R8) that talk to (C18) to the player, providing instructions (A5) and narrative context (R9) to the gameplay. Voice overs also provide hints (C15) and guide the player during gameplay, and oral instructions are used to incorporate a language comprehension component into some math problems. Levels (C5) are structured into lessons which become progressively harder, adding time restraints (C13) and limited attempts in the form of lives (C11) into the mix. Sound effects are used to signify wrong answers (C17), while a different, more supportive sound effects such as applause are used in conjunction with animations such as confetti (C20) when the player answers correctly or completes a goal. Golden acorns (C2) are also handed out as a reward after completing a level.

Figure 10. Mathseeds

Figure 10 showcases a cutscene in action and the interface, which shows how many acorns the player has accumulated. The acorns can be used to play arcade games (A4). These mini-games are not as structured and regimented as the lessons (A2) and allow for direct control (C21), but much like real arcade games, the play time is limited and must be purchased with currency, so they can only be enjoyed briefly in-between lessons as a reward. There are also optional challenges (C14) which do not require acorns to be

played, but impose a time-limit (C13) on the player. For example, in mental minute the player has 60 seconds to perform as many calculations as possible. When you near the end of the time-limit, the background music (C19) becomes faster and there's a sound of a ticking clock, enhancing the time-pressure. Upon succeeding in these challenges, the player receives badges and achievements (C9) displayed in the profile page (C10). You can also find unlockable content (A7) from this page in the form of clothing options (A8) that the player can purchase and equip on the player character (A9), as shown in Figure 11.

Figure 11. Mathseeds

This ability to visually customize the player character is a feature that both Zapzap and Mathseeds share.The main pedagogic difference between the two seems to be that the latter doesn't include competition, but uses narrative and spoken language more richly in math education. Mathseeds uses voiced instructions and spoken and mixed forms of numbers, such as "12 hundreds" in exercises, which might affect the learning process.

6.1.4. Music

I chose music learning apps (classified here as games) Big Ear and Yousician to represent the category of music games. Both games were played on mobile using free versions.

Big Ear also features character customization (A9). The player controls Solo (A12), one of the six musically themed (R7) alien creatures (R8) that introduce the player to the game in the intro screen. You can customize Solo with different kinds of hats, which can be bought via coins (C2) from a shop that also sells treasures and new instruments (A8). Coins can be earned by completing tasks and playing the game daily, as the first daily game session grants a coin reward. A streak feature (C7) doubles this reward upon four consecutive days of playing the game and triples it on the seventh day. While player is incentivized to play daily, the length of these sessions is limited by design with lives (C11) which regulate play time.

Figure 12. Big Ear

Figure 12 showcases the level selection tool of Big Ear, which showcases the players' score (C4) in each level (5), as well as the player level (R2), amount of diamonds and coins (C2) and lives. Each exercise or level is presented as a physical area within the game world, which collectively form a path that the player character or avatar traverses through as the player makes progress. This way of visualizing exercise progression mimics the level selection and overworld features of commercial entertainment games such as Super Mario Bros. 3, and was also used in Code Monkey and Mathseeds.

Beyond learning universal musical concepts, Big Ear allows players to choose from (A6) four distinct musical genres to study. Puzzle levels task the player to click sound producing objects (A5) to create rudimentary rhythms and melodies. Upon completion Solo jumps on the objects (C21), which bounce him above obstacles in the level, and create sounds (C17) and music (C19) in the process. Upon completing a level, animated feedback (C20) and a score are provided, and the player is given compliments (C16), currency and experience points (C3). The experience points are added to a progress bar (C6) which tracks the player level. Composer and performance modes can also be unlocked (A7) by completing puzzle levels.

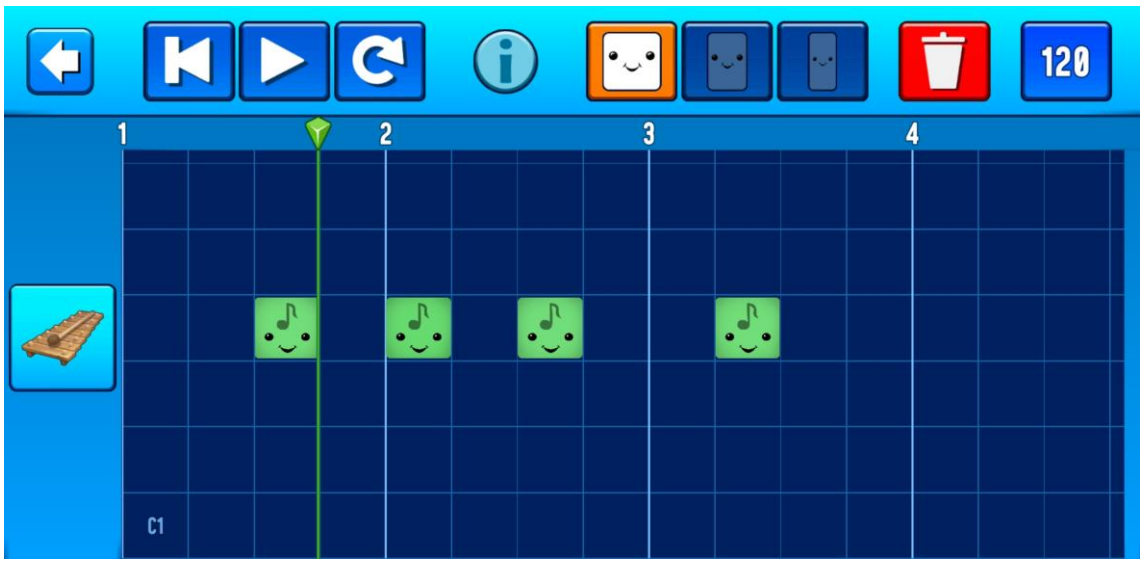

Figure 13. Big Ear

Figure 13 showcases the composer mode (A2), which lets players create their own songs (A11). Players can freely create compositions, listen to them and rewind progress (A3) in the composer mode. Performance mode in turn gives a chance to compete in leaderboards (C1) by practicing pre-defined songs, which can also grant free hats as a reward for completion. Time spent in these modes is tracked in the profile page (C10), which also tracks the players level, favorite instruments and completed songs.

A similar profile page (C10) tracking play time, player level (R2), weekly streak (C7) and friend list (R4) is found in Yousician. The game has a much more simulationistic approach than Big Ear though, using real life photos and videos (R6) in its aesthetics and simulated instruments in exercises. Yousician allows players to improve their singing and

practice multiple different instruments, out of which I chose piano lessons. Singing lessons allow players to choose between different lessons (A6).

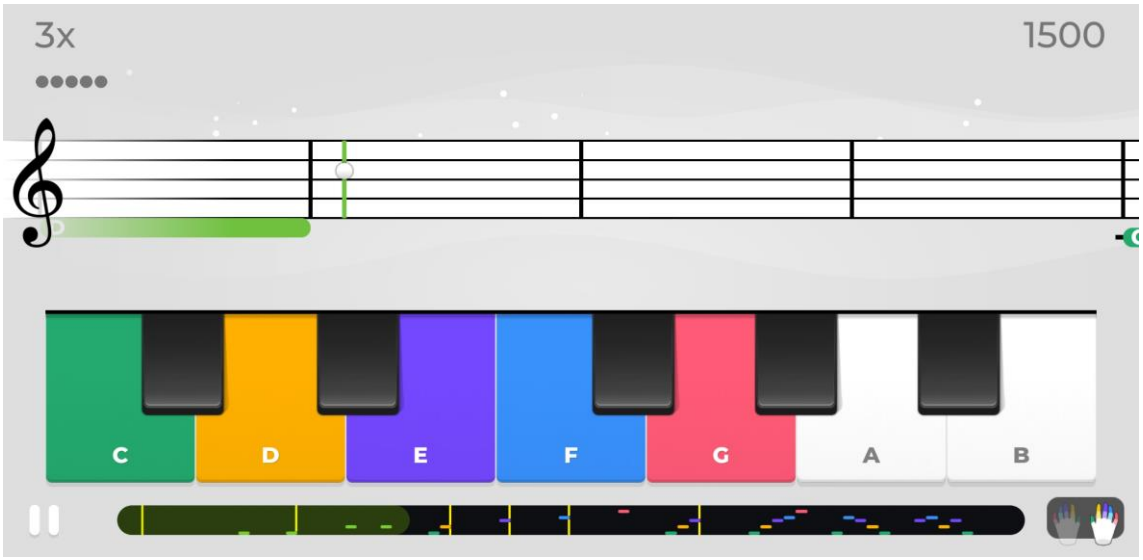

Figure 14. Yousician

Figure 14 showcases gameplay of a piano lesson. The game emulates playing a piano by making the player press virtual keys on their phone screen. The lessons task the player with playing the right notes (A5) as a song (C19) is playing. Each key is color coded and the interface shows upcoming notes in advance in a progress bar (C6) at the bottom of the screen. Playing correctly increases score indicated in the upper right corner. A multiplier in the upper left corner also provides performance feedback by growing larger when multiple notes are played successfully (C7) and decreasing when mistakes are made. At the end of the lesson players' performance is graded (C4), which is accompanied by a sound effect (C17) and a verbal compliment (C16, C18).

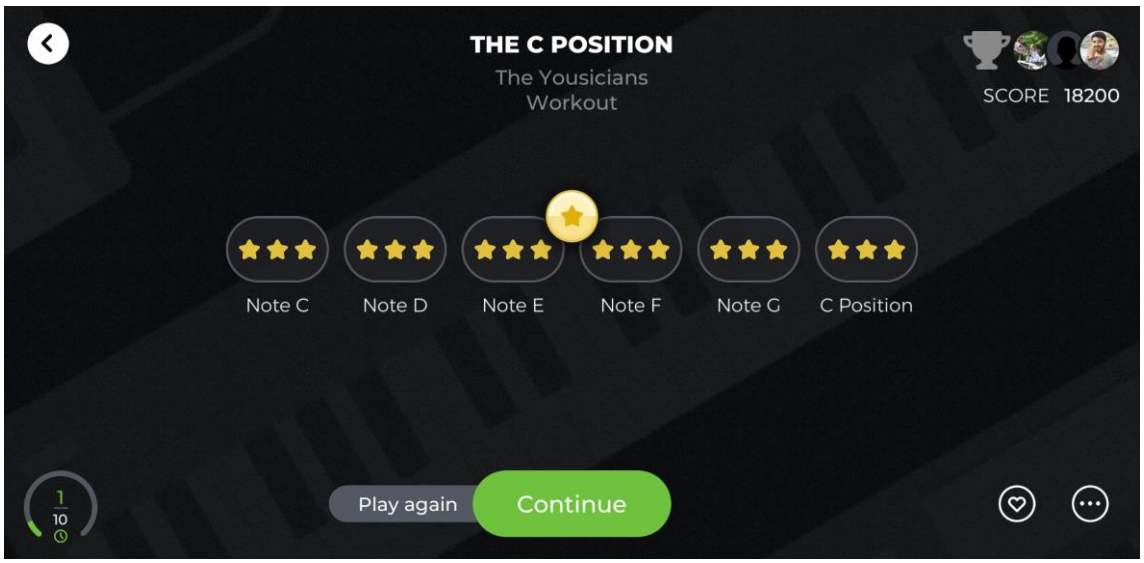

Figure 15. Yousician

Figure 15 showcases how the game contrasts the players' score to that of others, whose Facebook profile pictures are show in the upper right corner. Each song has a leaderboard (C1). Weekly challenges (C14) provide new songs for players to compete in.

You could argue that Yousician isn't so much an educational game as it is a simulation. It gives players direct control to play an instrument, whereas in Big Ear you play a game to make the game produce music. Big Ear does include a game mode that allows freeform music composition however. So while Yousician teachers players to play instruments themselves, Big Ear focuses more on learning to produce music digitally. The contrast in aesthetics between the two implies that they are aimed at different age demographics. Not only is Big Ear more cartoony and game-like in its structure, it also offers more gamified external motivators that do not relate to the goal of music education, such as virtual currency and character customization. While Yousician contains less of such game elements, it arguably still incorporates gamification to its design through scoring elements that encourage competition against other players.

6.1.5. General

Much like in the last category, I chose two games with very different target demographics to present this category. Papumba academy is a collection of learning games and activities for toddlers and preschoolers focused on training different skills like drawing and memory (Matte, 2019). Elevate is a brain training app that uses 35 different games to train the users math, reading, writing, speaking and listening skills and boost their productivity (elevateapp, n.d). It won Apple's App of the Year award in 2014 (Graham, 2014). I played both games on mobile using the free/trial versions.

Papumba gives players a selection of different exercises to freely choose from (A6), which take place in different settings like the wild west or space (R7). These exercises vary in their goals and objectives, some let the player color pictures (A2) while others have specific goals (A5) such as matching tiles. Animal and human characters (R8) that are sometimes voiced (C18) can contextualize these (R9) goals by giving the player tasks such as cleaning up an ocean. These characters can react to players' actions (C20), for example a frowning whale covered by oil will start smiling upon being cleaned up by the player character (C21). Levels (C5) also provide auditory through a soundscape (C19) of animal noises and nature sounds.

Figure 16. Papumba

Progress within levels fills up a progress bar (C6) that features a present at the top, as shown in Figure 16. Upon completing a level, players are complimented (C16, C17) and allowed to click open (C20) this present, then bursting at the seams eager to be opened. You can find stickers (A7) from these presents. You can see which stickers you've

unlocked from a page (C10) which tracks your collection, as shown in Figure 17. Players avatar (A12) can also be personalized from the settings menu.

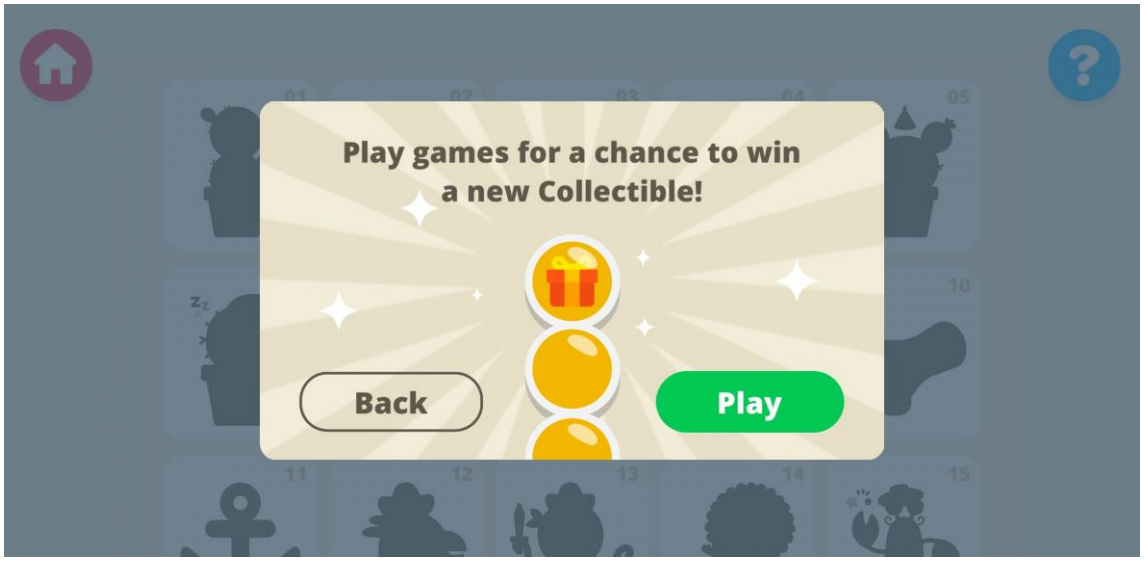

Figure 17. Papumba

Elevate provides a wide variety of exercises that test and develop different aspects of the players language and math skills. One game might test the players reading speed, while another might task them to reduce redundancy from sentences by removing useless filler words (A5). Time-pressure (C13) is a central part of each exercise, as all of them have a time limit. Quick answers also improve scoring (C4). Some exercises feature score streaks (C7) as well. Abundance of numeric data is the most distinguishing feature of Elevate when compared to Papumba or other games featured in this analysis. Performance graphs (C8) and progress bars (C6) are provided for all exercises, and the players performance is contrasted to average and median values of all players.

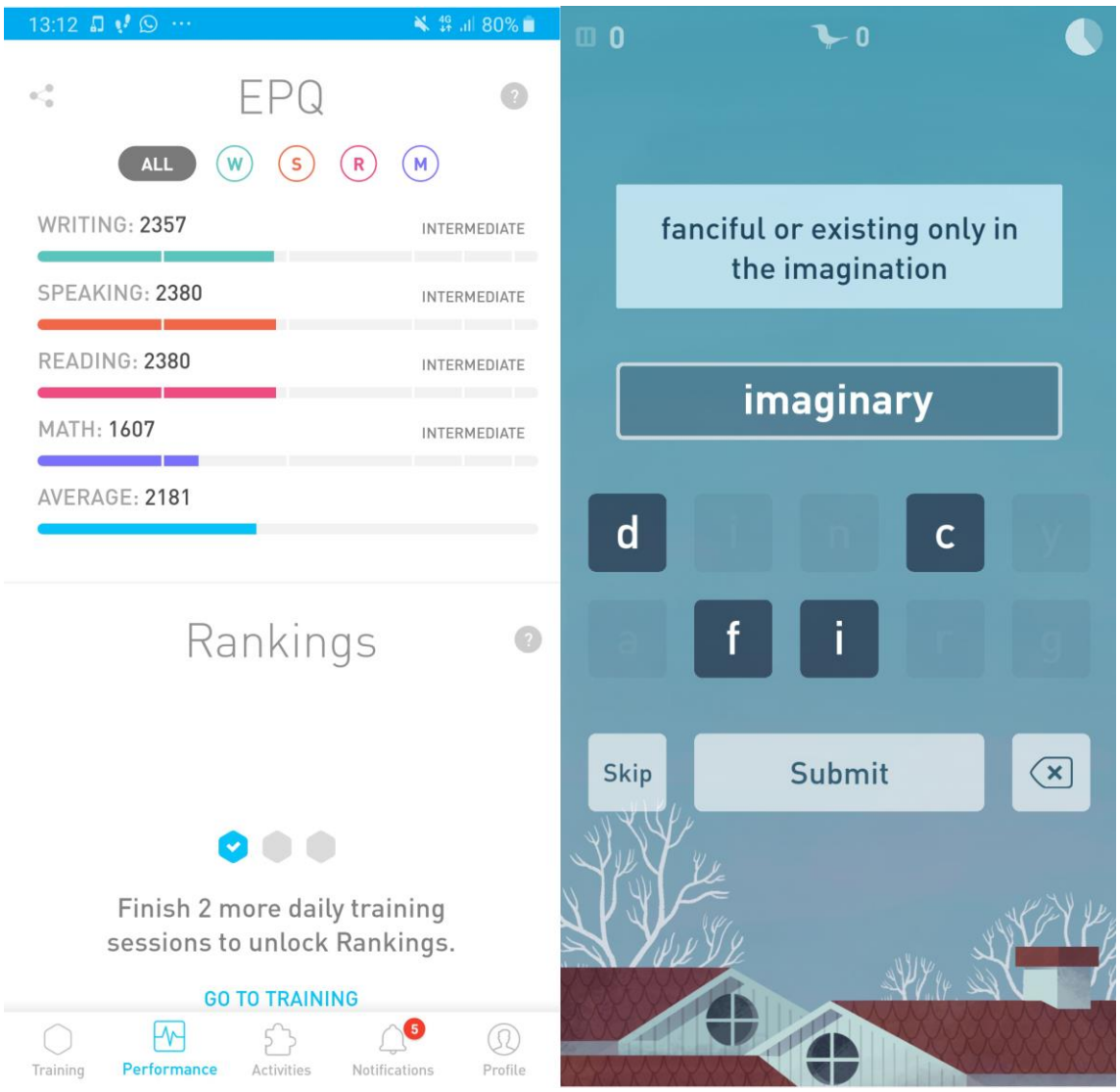

Figure 18. Elevate

Rankings (C1) and new games and study materials can be unlocked (A7) by completing exercises as shown in Figure 18. Achievements (C9) can also be unlocked, which are shown in the profile page (C10). The profile page also tracks the players weekly streak (C7) and contains a referral program (R1) as showcased in Figure 19.

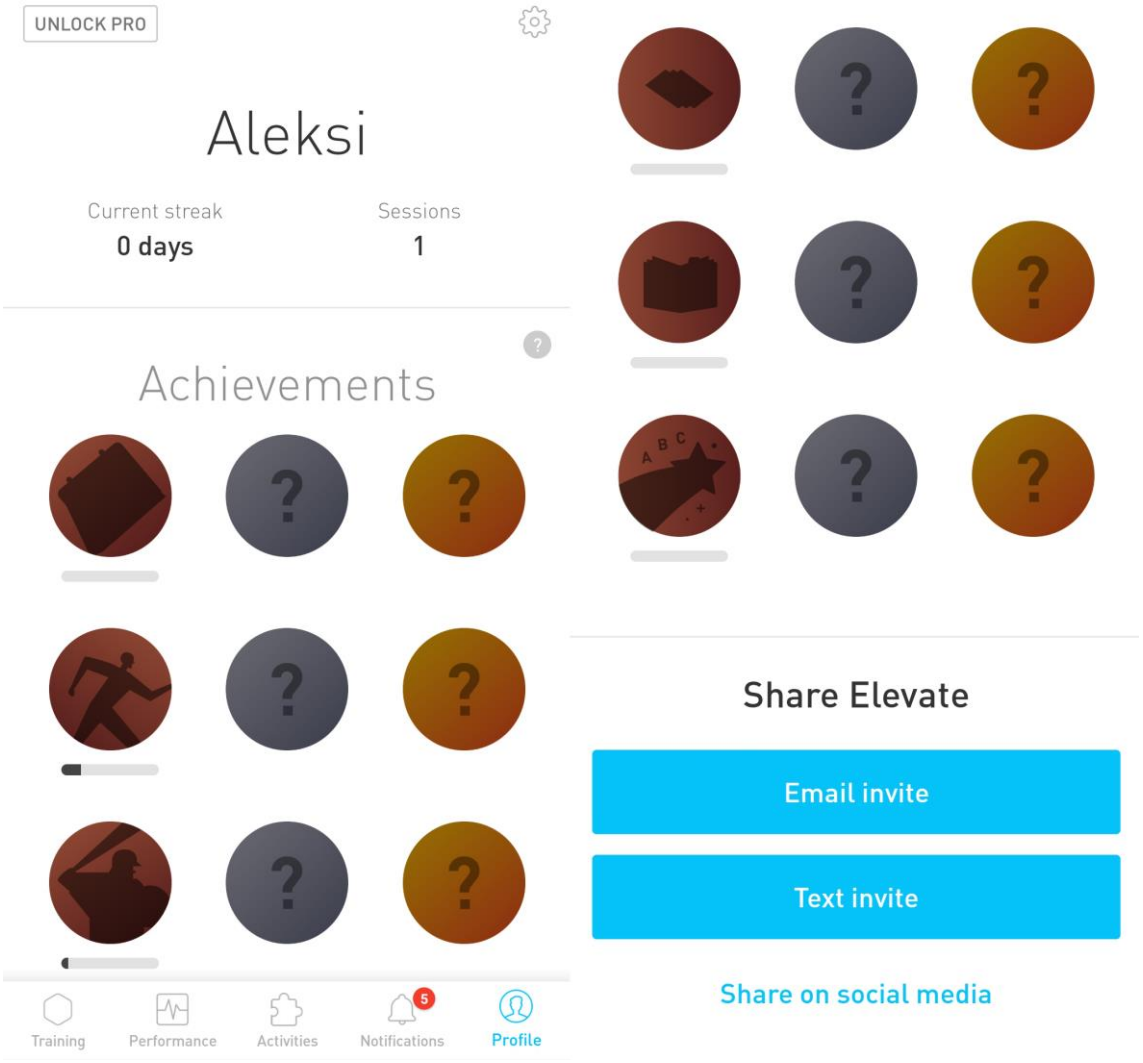

Figure 19. Elevate

The visual presentation of Elevate is very minimal. It mostly uses geometric and abstract shapes and patterns as background imagery. While the illustrations occasionally show relatable real-life imagery, such as a house or a sunset at the ocean, they do not relate to tasks and goals in the game, so I chose not to identify the simulation aesthetic element in it. Sound effets (C17), music (C19) and feedback animations (C20) are used in the exercises however, as well as clues (C15).

Papumba is far more visual and far less performance oriented than Elevate, likely due to being a game aimed at toddlers, so the games do not really share many similarities beyond their multidisciplinary nature.

6.2. Results

The results of the formal analysis conducted in Chapter 6.1 are shown in Figure 20, which maps them to my framework formulated in Chapter 5. The framework color-codes autonomy, relatedness and competence as yellow, red and blue respectively. Elements where these SDT components overlap and transition to one-another are highlighted with orange and purple in turn. I will discuss these results in greater detail in Chapter 7.1.

SDT category	Dynamic	Game element	Code	Duolingo	Busuu	Coding galaxy	Code Monkey	Zap Zap	Mathseeds	Big Ear	Yousician	Papumba	Elevate
Autonomy	Exploration and Experimentation	Continuous game world	A1										
Autonomy	Exploration and Experimentation	Freeplay	A2				■		■	■		■	
Autonomy	Exploration and Experimentation	Replay	A3			■	■			■			
Autonomy	Exploration and Experimentation	Mini-games	A4				■		■				
Autonomy	Choice and Control	Clear Goals	A5	■	■	■	■	■	■	■	■	■	■
Autonomy	Choice and Control	Multiple Routes to Success	A6	■	■		■	■		■	■	■	
Autonomy	Choice and Control	Unlockable Content	A7	■				■	■	■		■	■
Autonomy	Self-Expression and Creation	Virtual Goods	A8	■				■	■	■			
Autonomy	Self-Expression and Creation	Character Customization	A9	■				■	■	■			
Autonomy	Self-Expression and Creation	Player housing	A10					■					
Autonomy	Self-Expression and Creation	Player-generated content	A11				■			■			
Autonomy	Self-Expression and Creation	Avatar	A12			■	■	■		■		■	
Relatedness	Social Interaction and Engagement Loops	Gifting or Referrals	R1	■									■
Relatedness	Social Interaction and Engagement Loops	Player level	R2	■						■	■		
Relatedness	Social Interaction and Engagement Loops	Visual Status or Rank	R3	■									
Relatedness	Social Interaction and Engagement Loops	Friend list	R4	■	■						■		
Relatedness	Social Interaction and Engagement Loops	Chat or messaging	R5										
Relatedness	Narrative and Visual Context	Simulation aesthetics	R6	■	■		■		■		■		
Relatedness	Narrative and Visual Context	Fantasy aesthetics	R7			■		■		■		■	
Relatedness	Narrative and Visual Context	Characters/NPCs	R8	■		■	■		■	■		■	
Relatedness	Narrative and Visual Context	Narrative Context	R9				■	■	■			■	
Relatedness	Narrative and Visual Context	Cutscenes	R10				■		■				
Relatedness	Collaboration and Competition	Teamwork	R11										
Relatedness	Collaboration and Competition	Collaborative Actions	R12		■								
Relatedness	Collaboration and Competition	Player roles/classes	R13										
Relatedness	Collaboration and Competition	PvP Competition	R14					■					
Competence	Collaboration and Competition	Leaderboards	C1	■				■		■	■		■
Competence	Progression and Rewards	Virtual Currency	C2	■					■	■			
Competence	Progression and Rewards	Experience Points	C3	■						■			
Competence	Progression and Rewards	Score/Grade	C4			■	■	■		■	■		■
Competence	Progression and Rewards	Levels	C5			■	■	■	■	■		■	
Competence	Progression and Rewards	Progress Bar	C6	■	■	■	■	■		■	■	■	■
Competence	Progression and Rewards	Score or play streaks	C7	■	■					■	■		■
Competence	Progression and Rewards	Performance Graphs	C8	■	■			■					■
Competence	Progression and Rewards	Badges/Achievements	C9	■			■		■				■
Competence	Progression and Rewards	Profile Page	C10	■	■				■	■	■	■	■
Competence	Risks and Challenges	Lives	C11					■	■	■			
Competence	Risks and Challenges	Playing/Difficulty levels	C12										
Competence	Risks and Challenges	Time-pressure	C13						■				■
Competence	Risks and Challenges	Quests/Optional challenges	C14			■	■		■		■		
Competence	Audiovisual feedback and Reinforcement	Clues	C15	■					■				■
Competence	Audiovisual feedback and Reinforcement	Compliments	C16	■	■		■	■	■	■	■	■	
Competence	Audiovisual feedback and Reinforcement	Sound effects	C17	■	■	■	■	■	■	■	■	■	■
Competence	Audiovisual feedback and Reinforcement	Voice acting	C18					■	■		■	■	
Competence	Audiovisual feedback and Reinforcement	Music/Soundscape	C19			■	■	■	■	■	■	■	■
Competence	Audiovisual feedback and Reinforcement	Animated feedback	C20		■	■	■	■	■	■		■	■
Competence	Audiovisual feedback and Reinforcement	Animated Avatar	C21			■	■	■	■	■		■	

Figure 20. Formal analysis results

7 DISCUSSION

I will discuss and analyze the implications of my results in this Chapter. I will then draw conclusions of my research in Chapter 8.

7.1. Analysis of results

Some common themes can be witnessed across all 10 games in Figure 20. Some elements are ubiquitous such as Clear Goals (A5) and Sound Effects (C17). Elements with no representation are more common however: not a single game included freeform exploration (A1), roleplaying elements (R14), multiple difficulty levels (C12), teamwork (R11) or a chat feature (R5). There are few different conclusions which can be drawn from this.

First of all, the list of elements I established and how I chose to demarcate their definitions has an effect on the results. Clear Goals could arguably be considered as a pre-requisite of a game, and educational games with clear pedagogic targets in particular are very likely to include tasks and exercises with specific, explicitly stated goals, so it makes sense that every game would feature them. However, there's a degree of ambiguity in many elements. For example, some games in my study such as Zapzapmath feature different student grades which affects the content and its difficulty, but I did not identify that as multiple difficulty levels, which I defined in the more traditional video game sense of having an easy, intermediate and a hard mode aimed at the same age or target demographic. This element is the only way I decided to account for the game/design concept of optimal challenge in my framework, which arguably were facilitated in other forms in some of the games, such as personalized study plans in Busuu. Similarly, some games like Duolingo use push notifications to drive user retention, but this feature is not accounted in the framework as an element as I did not find a theoretical basis to link it to. Much like how framing of a photo affects journalism, the elements I exclude outside my framework affect its nature.

An all-encompassing feature list of game elements would be hard to produce, so I had to limit the scope and granularity of elements and their definitions at some point. The central conflict of this process was trying to find balance between an attempt to maintain validity by relying on existing definitions and using a methodology that allows me to shape and establish new definitions shaped by the needs of my research and its context. My aim was

to minimize ambiguity in establishing these definitions, but whether or not some of them are too arbitrarily defined remains a concern. In terms of numbers, this process of trying to expand existing theory tripled the number of identified elements. While Seaborn & Fels (2015) identified 14 elements and the articles presented in chapter 4.3 used anywhere from 7 to 16 elements, my framework includes 47 elements. However, the elements in those articles generally focused on concept or dynamics, while my elements are more specific and granular manifestations of these dynamics. While based on characteristics and categories identified in gamification research, some of my elements such as A1 (continuous game world) arguably relate more to commercial game design than gamification. When it comes to entertainment games and their elements and design patterns, Bjork & Holopainen (2005) identified multiple hundreds of elements. They do not list purely retention driven elements such afore-mentioned push notifications or referrals (R1), which I include in my framework, so my element list exists somewhere between these two polarities.

While it could be argued that it thus fails to stay within the confines of gamification and its definition that I use in this thesis, I posit that these elements that expand previous gamification element lists highlight underrepresented and unexplored areas in gamification design, such as freeform exploration (A1) and player roles/classes (R13). As said, these elements still draw from concepts featured in prior gamification research, for example R13 is a specific mechanical manifestation and one of the components of roleplaying, which was included as a gamification element in one of the articles in Chapter 4.3 (Nah et al., 2013, 103-105).

The most fundamental issue that these underrepresented elements highlight across all 10 of the games is the lack of direct control and autonomy in comparison to entertainment games. While 6/10 games included animated avatars, direct control of the avatar was only used in the context of mini-games (Mathseeds, Papumba) and player-generated content (Code Monkey). With direct control, I refer to the ability to control the movement and actions of the avatar freely in real-time, whereas in most of the game the game moves the character for the player after they perform an input, such as in Coding Galaxy or Big Ear. I do not count playing musical instruments in Yousician as avatars in this context. As discussed in Chapters 3.5 and 5.4, being allowed to control the movement and controls of the game character in a similar manner as in an entertainment game on a video game console could make the gameplay experience more engaging by adding a sensation of

game feel, increasing sense of control and autonomy and allowing competence through game mastery.

The reason these games might be hesitant to base their gameplay around direct control could stem from wanting to make the barrier to entry as minimal as possible, as Whitton (2009, 122-124) explained when comparing the differences between entertainment and educational games. The limitations of the mobile platform also make it harder to implement real-time movement on a touch screen. Majority of the games were also aimed at children, which could contribute to unwillingness to grant too much freedom or control to the player. For example, the social elements were more fleshed out in games aimed at an older audience (Duolingo, Busuu and Yousician), providing more information of players, full names and pictures of the person. Parents and guardians might be more hesitant to allow small children to present themselves with their real name and picture online. That being said, no game allowed for direct social interaction or messaging (R5) between players or included social groups and dynamics in the form of guilds or player roles (R13). Multiplayer in general was an underutilized element, as no game included teamwork (R11) and only one game had PvP competition (R14).

These elements might've been more well-represented if different games had been chosen for the analysis. This selection of games doesn't seek to showcase the full range of gamification, but rather provide examples from different fields to analyse their applications of it. While I posit that consistent patterns across these applications could be generalized to discuss trends in educational gamification to some extent, it should be stated that this particular selection of games influenced how this thesis developed. The content of these games impacted how the framework was formulated, and their terminology affected the results.

For example, I define profile pages (C10) as a feature that tracks and showcases the players accomplishments such as achievements (C9). This could be interpreted as a complete symbiosis, but Busuu has a feature/page called "Profile" yet no achievements, so I identified C10 but not C9 in it. Papumba also features a page where the players sticker collection is show, so it was identified as C10 despite the lack of C9, even though the game doesn't call this feature a profile page. Conversely Code Monkey includes achievements but has no separate page for them, as achievements are listed alongside courses and game-builder option in it, so it has C9 but not C10. Virtual Currency (C2) and Virtual Goods (A8) and Experience Points (C3) and Player Level (R2) have a similar

relationship. Player level inherently implies that there are experience points in the game, but I identified levels in Yousician but did not see references to experience points anywhere in the interface, so only the former was identified. My sub-division of points to score, experience points, virtual currency resulted in this split, where points are classified as a form of reward/reinforcement, which then allows expression of autonomy or relatedness through virtual shopping, visual status or player level and so on.

Avatars are another potential point of confusion in my framework. Mathseeds features animated avatars (C21), yet no avatars (A12). Duolingo has character customization (A9) but no avatar (A12). How can that be? Avatar can be defined as the character that you control in a game. Profile pictures can also be labelled as avatars. I defined avatar as a vehicle of self-expression and identification based on some level of choice and control in physical appearance. The central defining characteristic of this interpretation is that avatar represents the player in the game. This could simply be through a static 2D icon, or a fully animated and 3D modelled character with customizable gender, appearance and outfit at the other end of the spectrum.

Games like Duolingo and Yousician that use the players Facebook profile picture as their representation do not have avatars by this definition, as the player has no choice in the matter, while games like Papumba and Code Monkey that allow the player to select their profile picture from a list of cartoon illustrations fulfil the requirement. As previously mentioned, these games affected the way I defined the elements in my framework, as Code Monkey calls these profile pictures avatars. These simplistic cartoon characters are objectively far less representative of the player than an actual picture of them, but as an autonomy supporting feature, I've embedded player choice as a requirement of the element. While representation of the player that supports identification with the avatar is one of the functions of an avatar discussed in Chapter 5.1.3, fantasy fulfilment has been identified as another function that they can fulfil (Read & Reeves, 2009, 94-95). While static profile images allow for the player to make a decision, it is limited to a one-time choice. Character customization (A9) accounts for the ability to customize avatars and game characters over time. Therefore it also covers buying new outfits to a game character (R8) that is not an avatar or representation of the player, such as Duo in Duolingo. Solo in Big Ear on the other hand acts similarly as a character like Duo, but as he is the player character (C21) which you can customize (A12), I classified him as an avatar.

This brings us to the most confusing element relating to avatars, animated avatars (C21). Despite the name, this element acts independently of avatars. While animated feedback (C20) covers general and non-specific animations relating to player feedback and reinforcement, such as a display of fireworks upon completing an exercise, animated avatars are instantaneous feedback to player actions that stem from game characters in particular. For example, a smiling character might start frowning as soon as the player inputs a wrong answer to a math problem. Direct control of the game character is not required for this element, but it is covered by it. Because of this, in Code Monkey the avatar (what the game calls the profile picture) and animated avatar (the characters you can control directly in the mini-games) function independently from one another, while Mathseeds doesn't have an avatar even though it features animated avatars. You do have a character that you can customize Mathseeds so the choice element of an avatar is accounted for, but like Duo in Duolingo, this character doesn't seem to represent the player. Unlike in Zapzapmath and Big Ear, you do not play as this character in any of the levels I completed, so I chose not to categorize it as an avatar.

Admittedly these elements could be named better. Creating separate categories for avatars and profile pictures, character animations and animated avatars, would reduce ambiguity, which should improve consistency and validity. Similarly Score or play streaks (C7) could be divided into two separate elements, as score streaks provide instant performance feedback while play streaks track daily activity and incentivize the player to play consistently. Both mechanics are referred to simply as streaks in games such as Duolingo and Elevate. This again highlights the semantic differences in game terminology present both in gamification literature and the games I analysed. Although my intention was to establish a consistent vocabulary in my framework to make my analytical guidelines as standardized as possible, a degree of interpretation was still present in my application. For example, I defined cutscenes (R10) as animated videos and thus did not count real-life footage in Yousician as such, even-though they do not technically conflict with the definition I referenced in Chapter 5.2.2. Similarly, my utilization of Characters/NPCs (R8) was largely based on the condition that a character should have a name, so unnamed characters in Zapzapmath were not counted as R8.

Because of this, it should be stated that a higher quantity of identified elements doesn't necessarily make a game better. Busuu and Yousician had the lowest amount of identified elements, close to 50% less than their counterparts, yet their individual elements might

pose pedagogic benefits. Busuu has been claimed to be better at teaching a language than Duolingo due to its peer review feature (Ekstein, 2017), while the simulated instruments in Yousician certainly should allow players to learn music skills on a more practical level than Big Ear. Duolingo had more elements than every other game besides Mathseeds and Big Ear, yet many of the titles with far less elements, such as Coding Galaxy, pose more impressive production values and arguably more extensive gamification efforts. While multiple elements are required to make a game an effective learning experience, it is the interplay between these elements that makes them most effective according to Kapp (2012, 50).

As previously established, the interrelation of elements isn't a part of my analysis or framework. The efficacy of individual elements isn't accounted for in framework either, so a game with simple graphics and minimal animated feedback is on equal standing with a game that boasts much higher production values. Adding an evaluation system within individual elements could be a way to alleviate this problem and make a game with limited well implemented elements stand on more equal ground with a game that has twice as many elements with shallow implementations. Whether or not the game matches learning goals set by official curriculums could also be used as an evaluation metric. The different educational backgrounds and goals of the games also could have an effect on the elements they include. For example, neither language game uses scoring (C4), while both programming games do. While no conclusions can be drawn from a sample size of two, hypothetically this could indicate that this particular element doesn't lend itself to language learning and exercises as well as programming.

7.2. Analysis of the method

While I compared games of each category with one-another in Chapter 6.1, the purpose of my formal analysis isn't to assess their educational value, rank them hierarchically nor state or imply that one game would be better or worse than its competitor. These games are simply case examples I've used to study gamification of education. They use different business models, have different target demographics and design backgrounds. Some are aimed at toddlers, others to elementary school education, the rest to adolescents and adults. Some are designed for classroom use in primary education where children are forced to play them, while others are designed for the app market where they have to compete for attention, visibility and downloads. This shift in context could have a particularly large impact on design. It should also be iterated that I do not belong to the target audience of most of these games.

That being said, formal analysis studies games independent of context (Lankoski & Björk, 2015, 23). While I've provided background info and hypothesized how the pedagogic backgrounds and goals of each game might affect their design and implementation of gamification, and vice versa, the focus of my analysis is in the game elements. Whether the educational context of my game analysis is congruent with this principle of formal analysis could perhaps be debated. I nonetheless chose to use formal analysis because Bjork & Holopainen (2005) also used it to derive a list of game elements according to Lankoski & Björk (2015, 23). Formal analysis also suits my research goals because its results can be used for further analysis and contrasted to other sources (Lankoski & Björk, 2015, 23), which I will do in the Chapter 8. I will contrast the results of my formal analysis and literature review in the chapter to answer my research question of "How could gamification of education be expanded or improved in the future?". Formal analysis also allowed me to demonstrate the use of my framework in an evaluation context. In the next chapter I present an expanded version of the framework that takes into account the results of the study.

7.3. Improved framework

This chapter introduces an improved version of my framework that takes into consideration the results of Chapters 5.4 and 7.1.

Need	Dynamic	Theory	Game element	Code
Autonomy	Exploration and Experimentation	IMI, IDP, IML	**Continuous game world**	A1
Autonomy	Exploration and Experimentation	IMI, IDP, IML, Scaffolding, EG	**Freeplay**	A2
Autonomy	Exploration and Experimentation	IMI, IDP, IML	**Replay**	A3
Autonomy	Exploration and Experimentation	IMI, IDP, IML	**Mini-games**	A4
Autonomy	Choice and Control	CA, Flow	**Clear Goals**	A5
Autonomy	Choice and Control	IDP, Flow, UC	**Multiple Routes to Success**	A6
Autonomy	Choice and Control	OC, IDP, SCT	**Unlockable Content**	A7
Autonomy	Self-Expression and Creation	OC, EP, CE	**Virtual Goods**	A8
Autonomy	Self-Expression and Creation	IDP, IML, PPI, UC	**Character Customization**	A9
Autonomy	Self-Expression and Creation	IDP, IML, IWI, UC	**Player housing**	A10
Autonomy	Self-Expression and Creation	IDP, IML, UC, EG	**Player-generated content**	A11
Autonomy	Self-Expression and Creation	IDP, IML	**Profile picture**	A12
Relatedness	Social Interaction and Engagement Loops	SEL, EP, RA	**Gifting or Referrals**	R1
Relatedness	Social Interaction and Engagement Loops	IML, PPI, EPE, GH, HT	**Player level**	R2
Relatedness	Social Interaction and Engagement Loops	IML, SEL, PPI, SEL	**Visual Status or Rank**	R3
Relatedness	Social Interaction and Engagement Loops	SEL, SC	**Friend list**	R4
Relatedness	Social Interaction and Engagement Loops	SEL, SC	**Chat or messaging**	R5
Relatedness	Narrative and Visual Context	CA, SLT	**Simulation aesthetics**	R6
Relatedness	Narrative and Visual Context	IMI, IML	**Fantasy aesthetics**	R7
Relatedness	Narrative and Visual Context	Story, CA, EM	**Characters/NPCs**	R8
Relatedness	Narrative and Visual Context	CA, Story, ARCS, IDP	**Narrative Context**	R9
Relatedness	Narrative and Visual Context	Story, SCT, CA, EM	**Cutscenes**	R10
Relatedness	Collaboration and Competition	IML, SC, RA, SEL	**Teamwork**	R11
Relatedness	Collaboration and Competition	IML, RA, SEL	**Collaborative Actions**	R12
Relatedness	Collaboration and Competition	IDP, IML	**Player roles/classes**	R13
Relatedness	Collaboration and Competition	IML, PvP, SC, SEL	**PvP Competition**	R14
Competence	Collaboration and Competition	IML, PvP, HT, CA	**Leaderboards**	C1
Competence	Progression and Rewards	OC, EP, Anchoring, RF (VR)	**Virtual Currency**	C2
Competence	Progression and Rewards	OC, RF (FI)	**Experience Points**	C3
Competence	Progression and Rewards	OC, RF (FI), CA, Flow	**Score/Grade**	C4
Competence	Progression and Rewards	Shaping	**Levels**	C5
Competence	Progression and Rewards	CA, Flow, EPE, GH	**Progress Bar**	C6
Competence	Progression and Rewards	RF (AFI), LA, EPE, SCF	**Play streaks**	C7
Competence	Progression and Rewards	CA	**Performance Graphs**	C8
Competence	Progression and Rewards	OC, Shaping, IML	**Badges/Achievements**	C9
Competence	Progression and Rewards	IML, PPI	**Profile Page**	C10
Competence	Risks and Challenges	IMI, IDP, IML	**Lives**	C11
Competence	Risks and Challenges	Flow, ARCS	**Playing/Difficulty levels**	C12
Competence	Risks and Challenges	IMI,IDP, IML	**Time-pressure**	C13
Competence	Risks and Challenges	IMI, IDP, IML, Shaping, GH	**Quests/Optional challenges**	C14
Competence	Audiovisual feedback and Reinforcement	RF (FI),Flow	**Score streaks**	C15
Competence	Audiovisual feedback and Reinforcement	CA, RF (VR), ARCS	**Clues**	C16
Competence	Audiovisual feedback and Reinforcement	CA, RF (FI), Flow	**Compliments**	C17
Competence	Audiovisual feedback and Reinforcement	CA, RF (FI), Flow	**Sound effects**	C18
Competence	Audiovisual feedback and Reinforcement	CA, RF (VR)	**Voice acting**	C19
Competence	Audiovisual feedback and Reinforcement	CA	**Music/Soundscape**	C20
Competence	Audiovisual feedback and Reinforcement	RF(FI), Flow	**Animated feedback**	C21
Competence	Audiovisual feedback and Reinforcement	IDP, IML	**Animated characters**	C22
Stimulation	Sensation and physical stimulation	PPI, UC, SLT	**Avatar**	S1
Stimulation	Sensation and physical stimulation	CA, Flow	**Game feel**	S2
Stimulation	Sensation and physical stimulation	CA, Flow	**Motion controls**	S3
Stimulation	Mental stimulation	RF (VR)	**Randomness**	S4
Stimulation	Mental stimulation	EG, IDP, IML	**Transgressive play**	S5

Figure 21. Extended framework with theory

Figure 21 showcases the improved framework. The new framework introduces a new need category and theory section similar to that of Lewis et al. (2012) shown in Chapter 3.3. Avatar (A12) and Animated Avatars (C21) have also be renamed to Profile Picture (A12) and Avatar (S1) while Score or play streaks (C7) are split into Play streaks (C7) and Score streaks (C15) in the new framework. The new stimulation category contains two dynamics, sensation and physical stimulation and mental stimulation, the former of which overlaps with competence need satisfaction for elements C20, C21 and C22.

The theory section added in-between game dynamics and elements accounts for some of the additional motivational theories that might apply to these elements. The theories stem from the theories presented in Table 2 and Table 3 in Chapters 3.3 and 3.4, Koster's (2019) retention mechanics from Chapter 3.6, Csikszentmihalyi's (1990) components of Flow and Zichermann & Cunningham's (2011) Social Engagement Loops explained in chapters 3.4 and 5.2.1 respectively. The abbreviations of these theories used in Figure 21, their summarized explanations and assigned elements in the framework will be explained in Table 8.

Abbreviation	**Theory**	**Game element**
SLT	Social Learning Theory	Copying desired behavior (S1, R6)
CA	Cognitive Apprenticeship	Authenthic environment (R6, C18, R9, C19), feedback (C1, C4, C6, C8, C16, C17) + guidance (A5, C15, R10)
Flow	Flow theory	Clear Goals (A5) Immediate Feedback (C4, C6, C16, C17, C20), Optimal Challenge (C12), Control in the task (A6)
OC	Operant Conditioning	Rewards (A7, A8), points (C2, C3, C4), badges (C9)
ARCS	ARCS Theory of Motivation	relevant information (R9, C15), appropriate challenge (C12)
IMI	Malone's Theory of Intrinsically Motivating Instruction	Challenge (A4, C11, C13, C14), Fantasy (R7), Curiosity (A1, A2, A3)
IDP	Lepper's Instructional Design Principles for Intrinsic Motivation	Control (A9, A10, A11, A12, R13, S5), Challenge (A4, C11, C13, C14),

		Curiosity (A1, A2, A3, S5), Contextualization (R9)
IML	The Taxonomy of Intrinsic Motivations for Learning	Challenge (A4, C11, C13, C14), Curiosity (A1, A2, A3), Control (A9-A12, R13, S5), Fantasy (R7), Cooperation (R11, R12), Competition (R14, C1), Recognition (R2, R3, C9, C10)
Scaffolding	Scaffolding	Reduce guidance over time to make learner independent (A2)
EM	Episodic Memory	Evoke learners' emotions (R9, R10)
Anchoring	Anchoring	Judgements of value are contrasted to a baseline set in the beginning of the game (C2)
CE	Contrast Effect	Relativistic perception (A8)
EPE	Endowment Progress Effect	Accelerated behavior provoked by (illusion of) progress (R2, C6, C7)
LA	Loss Aversion	Preventing loss of rewards/progress is more motivating than progress/rewards (C7)
RA	Reciprocal Altruism	Reciprocal altruism (R1, R11, R12)
SCF	Sunk Cost Fallacy	Increasing commitment to justify a purchase or a habbit (C7)
GH	Goal-gradient Hypothesis	Expending more effort closer to a reward (R2, C6, C14)
Shaping	Shaping	Training subjects to perform more complex behaviors (C5, C9, C14)
RF (FI)	Fixed interval reinforcement	Positive reinforcement on a fixed schedule (C3, C4, C16, C7, C17, C20))
RF (AFI)	Avoidance fixed reinforcement	Negative reinforcement on a fixed schedule (C7)
RF (VR)	Variable ratio reinforcement	Positive reinforcement on a randomized schedule (C2, C18)
SCT	Steady Content Trickle	(A7, R10)
PPI	Persistent Profile Investment	(A9, A13, R2, R3, C10)

IWI	In-world Investments	(A11)
SC	Social Connections	(R4, R5, R11, R14)
EP	Economic Play	(A8, R1, C2)
PvP	Player vs Player	(R14, C1)
UC	User Creativity	(A6, A9, A10, A11, A12, A13)
EG	Emergent Gameplay	(A2, S5)
SEL	Social Engagement Loops	(R1, R3, R4, R5, R11, R12, R14)

Table 8. Theories in Figure 21

Table 8 showcases which elements I've assigned to each theory in Figure 21. This process was based purely on my personal interpretation of these theories, as described in the literature that I reference. The list of theories I employed is by no means exhaustive. This is merely a suggestion on how the framework could be supplemented by employing additional theory beyond SDT.

Including psychological needs and motivational drives and relating them to game elements could provide a short cut for moving between universal psychological and pedagogic concepts and the characteristics and features of digital games. This could potentially help bridge the communication gap between educators and game designers in the design process of gamification, where it is advised to include people from both professions and perspectives (Whitton, 2009, 139-140). Linking additional theoretical frameworks to individual elements could also further help designers evaluate their utility and purpose in the design process. While this framework was designed for Education Alliance Finland to use in evaluation of gamified systems, I posit that with further refinement, it could also prove to be a helpful tool in their design processes.

8 CONCLUSIONS

Beyond highlighting importance of context in successful gamification, research and design guidelines have cautioned designers to be mindful of differences between learning styles and motivations of players (Kapp, 2012, 142). For example, competition elements might stress and demotivate players (Whitton, 2009, 124), as well as carry the risk of shifting the mindset of competitive players from learning to performance (Harviainen et al., 2014, 67). One of the suggested solutions to this problem is to cater to different player types during the design process (Iosup & Epema, 2014, 28), such as the different player type taxonomies identified in Sezgin's (2020, 51-60) meta-synthesis on gamification design. Beyond the differences between these player types, motivation to play might be affected by other factors such as age, gender, cultural background and attitude and relationship towards games (Whitton, 2009, 37-40). For example, a study by Markus & Kitayama (1991, 231-235) identified differences in the motivations of western and east Asian students which stem from cultural differences relating to how individualistic or collectivistic mindset guided the students thinking processes. This could affect the universal applicability of claims and discoveries made by Western gamification research, which this thesis references predominantly.

The dynamics in my framework are not based on player types, but they correspond to similar motivations and needs. For example, Exploration and Experimentation, Social Interaction and Engagement Loops and Risks and Challenges correspond to "seeker", "socialiser" and "daredevil"/"conqueror" respectively in Nacke, Bateman & Mandryk (2011, 289-290) typology, one of the 11 player type taxonomies used by Sezgin (2020, 54-56). Although these dynamics could be refined and expanded upon, I posit that they can serve the purpose of embedding player types and motivations to game elements, if the framework is used as a design tool. The framework could also highlight underrepresented dynamics in the design process of gamification, although a high amount of elements and extensive feature list by itself does not indicate value or quality, as established in Chapter 7.1. I will use my results to demonstrate this point in this chapter.

The underrepresented elements in my analysis highlight areas of design where educational games are lacking in comparison to commercial games. The results of this case study cannot be extrapolated to gamification as a whole, but the prevalent patterns observed in it suggest faults and deficiencies that are congruent with contemporary criticism of gamification design presented in Chapter 2.2.3. Based on observations drawn from my results and literature review, I present the following non-exhaustive list of suggestions for improving and expanding gamification in the future:

1. Inclusion of avatars that the player can directly control and manipulate.
2. Shifting to more explorative and open-ended design that facilitates exploration, nonlinear progression and multiple paths to success through elements such as roleplaying, storytelling, replay and freely explorable game worlds.
3. Moving the primary design focus of gamification from extrinsic reward systems to enjoyable gameplay that emphasizes fun, creativity and the intrinsic value of the activity.
4. Exploring the educational potential of game modification as a cost-effective alternative to contemporary gamification solutions.

I posit that avatars that the player can control directly offer the most fertile ground for improving gamification. Although I defined avatars differently in my framework, I will use the word as a synonym of directly controllable player characters in this chapter for sake of simplicity. As explained in Chapter 5.1.3, avatars can improve learning and engagement via mirror neurons (Read & Reeves, 2009, 96). Offering players more control by incorporating avatars could address criticisms aimed at gamification, improve player experience and engagement as well as offer educational benefits.

The more a player can manipulate a game character and make decisions that have an impact on it, the more invested the player becomes according to Gee (2003, 3), who suggest that this investment is the largest motivator to continue playing a game and eventually master it. Game mastery, the ability to clearly identify and distinguish the gameplay of a skilled player from a novice (Bjork & Holopainen, 2005, 364-365), is an underutilized element in gamification based on my formal analysis. While to some degree this might be a conscious design choice based on improving accessibility and time-efficiency (Whitton, 2009, 122-124), I posit that this mostly stems from lack of avatars.

Learning to control and play a game is often key part of the fun for players (Whitton, 2009, 122-13), while demonstrating mastery at a game can be a significant reason to play for skilled players (Bjork & Holopainen, 2005, 357), whose continued engagement requires attention and new stimulus from the developers (Kapp, 2012, 142). Different elements such as timing, rhythm and dexterity-based actions support game mastery (Bjork & Holopainen, 2005, 363). Challenges and goals which require dexterity and hand-eye coordination were one of the three main motivators for playing digital games in Whitton's (2009, 39) study, while importance of rhythm was also highlighted in Mueller & Ibister's (2014, 2193-2197) guidelines for designing movement-based games. Timing also plays a large role in the design of many popular game genres (Bjork & Holopainen, 2005, 362-363). All these elements of game mastery require direct input and control by the player. This does not necessarily require a concrete game avatar, but generally such actions are performed and displayed through one (Read & Reeves, 2009, 64). There are successful games that support game mastery where the player does not have an avatar, such as *Tetris,* but they generally still allow the player the directly control and manipulate objects or units in the game. That said, there are commercial games like *Candy Crush Saga* where the player does not control any characters or objects in the game, but merely interacts with it through clicking objects on the screen.

In contrast the educational games featured in my analysis did not feature much direct control or interaction with the game world. Some did have elements of time-pressure or supported a sense of mastery with score streaks, but by and large their design did not facilitate displays of game mastery well or at all. Compared to commercial entertainment games such as fighting games, real time strategies and first-person shooters which have become spectator sports in contexts such as esports, the margin for game mastery was negligible in educational games. For example, the speed at which feedback animations played was generally unaffected by answering speed. The only interaction option the player has in some of the games is to choose an answer by clicking objects on the screen. The games which did feature characters that the player controls generally did not allow the player to directly manipulate these characters, but rather made them perform a feedback animation after the player provides an answer or an input. Direct control of an avatar in contrast would provide instant feedback to the players actions, which would improve the facilitation of flow and allow displays of game mastery.

Instant feedback and predictable results to player actions are also pre-requisites of good game feel (Swink, 2008, 297). The pleasurable sensation provided by good game feel is another important element that avatars could provide. While that might not offer any particular educational benefits by itself, I posit that a game that is enjoyable and fun to control is more intrinsically motivating to play, which should increase engagement and retention of players. As the players conduit for interacting with the game world (Bjorn & Holopainen, 2005, 78), avatars would also allow other underrepresented game elements, such as explorable game worlds (element A1 in my framework), to be incorporated into gamification. So beyond supporting competence need satisfaction through displays of game mastery, avatars could support players' autonomy through freedom to explore and experiment. Controlling the actions of the avatar would also support autonomy by giving the player a sense of control over their actions. Reward systems could be also improved upon by offering character upgrades, bolstering both extrinsic motivation and self-expression.

While that sounds good on paper, combining aforementioned elements with the educational goals and context of an educational game might be easier said than done. Even if you create an educational game with large and open-ended game environments and design various game mechanics for the avatar with considerable depth and capacity to support game mastery, making the gameplay congruent with the educational goals is a challenge. There is a risk that the gameplay might become "chocolate covered broccoli" that incentivizes the player to perform uninteresting and unmotivating educational tasks. Ideally, the gameplay mechanics should be inherently intertwined with the educational context and learning objectives of the game. As Whitton (2009, 41) posits, the real educational value of games lies in the sound educational principles that many embody, not in their motivational benefits.

It should be noted that gameplay doesn't have to be based around performing physical actions (such as jumping and fighting) with an avatar for it to be engaging. More cerebral entertainment game genres such as strategy games can be based purely on clicking menus and issuing commands to units that the player doesn't directly control, yet they can be highly engaging and addicting for the player. While they might not feature avatars and real-time controls, strategy games are not directly comparable to educational games either. They generally offer the player much more choices and control on how to achieve a goal, with multiple routes to success and considerably more depth. So, the players'

feeling of autonomy is supported to a larger extent, and there is a higher level of intellectual challenge involved in keeping track of multiple concurrent game systems and mechanics. This should have educational benefits as well, as having multiple paths to success and allowing students to devise their own strategies is one of the key characteristics of active learning according to Kiryakova et al. (2014, 2).

The educational games in my analysis on the other hand generally gave very specific tasks to the player, such as calculating a math problem or translating a sentence. So while the presentation of the game might have utilized game elements such as characters, avatars, level selection tools, player levels, virtual currency, virtual goods and character customization to allow the player a sense of control in the experience and a video game-like presentation, the actual gameplay trapped the player in a space where their degree of control and level of interactivity was severely limited. The degree to which the player could exhibit control and choice varied depending on context, so language and math games gave the player less choice than music and programming games. The underlying theme that can be extracted from this analysis is interactivity. The largest fundamental difference I identify between educational and commercial games stems from the level of interactivity that they offer to the player.

I suggest that the way to address this issue, and there-by address criticisms directed at gamification, is to reframe game-based learning from emphasizing repetition to explorative learning. Instead of focusing on memorization and practice, allowing students to learn in context, apply their knowledge and test their assumptions is the best way to utilize the learning characteristics and potential of games according to Whitton (2009, 66). Less guided freeplay (element A2 in my framework) would facilitate freedom to fail and learning from mistakes, which is one of the most often touted educational benefits of video games as explained in Chapter 5.1.1. Allowing nonlinear progression with multiple paths to success would also support active learning (Kiryakova et al., 2014, 2) and support students feelings of autonomy and mastery.

Harviainen & Meriläinen (2019, 557-558) also posit that instead of turning learning into a game, cultivating some of the intangible aspects of play could address some of the challenges of gamification. A playful approach would emphasize imagination, creativity, fun, collaboration and experimentation (Kangas, 2010, 11-13; Harvianen & Meriläinen, 2019, 557-558). A shift into a playful mindset would place more focus on the process than rewards and results (Harviainen & Meriläinen, 2019, 557), which would emphasize

the intrinsic value of the activity and help facilitate flow (Csikszentmihalyi, 2014, 145). Creativity, which can happen through lateral thinking and creative problem solving, facilitates engagement with educational games according to Whitton (2009, 146). This is another benefit of more open-ended and explorative solutions that allow multiple paths to success. I posit that such design would also have the advantage of facilitating different playstyles, taking into consideration differences between students, which could improve motivation and teach students not to get discouraged as there are usually multiple ways to reach a goal in real life.

An added benefit of an explorative and open-ended system could be added nuance and reflection. Reflection is an essential component of successful gamification of education (Whitton, 2009, 49; Harviainen et al., 2014, 73; Harviainen & Meriläinen, 2019, 556), so storytelling, which is linked to reflection and learning as explained in Chapters 3.5 and 5.2.2, could be utilized more in it. While narrative context can embed meaning to game content (Whitton, 2009, 146; Sailer et al., 2017, 173), branching narratives could support players autonomy while embracing the strengths of digital storytelling. None of the educational games in my study featured branching narratives. Roleplaying was also absent from these games, despite its educational benefits mentioned in Chapter 5.2.3. As the success of gamification is context dependent (Hamari et al., 2014, 6), more open-ended gamification solutions should utilize the domains of digital game-based learning in ways that support and fit the learning outcomes. For example, the new perspective, empathy and emotional engagement with characters from different backgrounds and cultures that roleplaying games enable (Jenkins, 2005, 51; Whitton, 2009, 69) could be used to teach history in a manner that utilizes the strengths and advantages of games and game-based learning.

Whitton (2009, 150) suggests game modification ("modding"), making modifications and extensions to commercial entertainment games, as one way of developing educational software. I posit that modding could provide a cost-effective method to develop such open-ended and explorative gamification solutions. Modding has an untapped educational potential according to Moshirnia & Walker (2007, 367), who suggest adding historical accuracy as a way to improve educational value of a game and provide players a chance for cultural reflection. For example, Rhett & Apperley (2019, 87-101) created a mod to represent the culture and history of indigenous people of Oceania more accurately in the commercial strategy game *Europa Universalis IV*. The benefit of modding is that it

requires less technical expertise (Whitton, 2009, 150), and modifying existing code and art assets is cheaper than developing a new game. This requires the player and developer to own and be familiar with the game being modified (Whitton, 2009, 150), but I posit that this could be an asset in the context of popular and widespread games such as *Minecraft* or *Fortnite*.

I suggest that modding could be used as a cost-effective solution to create a prototype game that tries to address the issues I've raised with gamification in this chapter. There's no guarantee that a more open-ended solution that includes the game elements mentioned in this chapter would prove to be more efficient or beneficial in motivation and learning metrics than contemporary education games, so more research and testing needs to be conducted to validate my hypothesis. Repurposing an existing commercial game to an educational purpose could prove to be easier than trying to make an educational task feel gameful by making a new game from the scratch. Such a prototype might not fit Deterding et al. (2011) definition of gamification on the account of being a full-fledged game, which is why Huotari & Hamari (2017, 25) warn designers to avoid fixating on the semantics of the definition too much, as their focus should be in the player experience. If more game-like solutions could match or surpass the educational benefits of contemporary gamification solutions, the techniques, tools, infrastructure and resources of the commercial game industry could be utilized more readily in education. Learning how to play the game itself is often a key part of the fun in commercial games (Whitton, 2009, 122-123), so ultimately, shouldn't the goal of gamification be the same by making learning itself fun and intrinsically motivating?

9 REFERENCES

9.1. Articles

Aarseth, E. J. (2007). I Fought the Law: Transgressive Play and The Implied Player. In Digra'07-Proceedings of the 2007 Digra International Conference: Situated Play (pp. 130-133).

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-centered design. *Bainbridge, W. Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications*, *37*(4), 445-456.

Adams, L. T., Kasserman, J. E., Yearwood, A. A., Perfetto, G. A., Bransford, J. D., & Franks, J. J. (1988). Memory access: The effects of fact-oriented versus problem-oriented acquisition. Memory & Cognition, 16(2), 167-175.

Adrup, J., & Skogström, C. (2016). Effekterna av spelmekanismerna ledartavlor, serier och certifikat på det dagliga stegantalet hos högskolestuderande studenter.

Alha, K., Koskinen, E., Paavilainen, J., Hamari, J., & Kinnunen, J. (2014). Free-to-play games: Professionals' perspectives. *Proceedings of nordic DiGRA*, *2014*.

Annetta, L. A. (2010). The "I's" have it: A framework for serious educational game design. Review of General Psychology, 14(2), 105-113.

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., De Freitas, S., Louchart, S., ... & De Gloria, A. (2015). Mapping learning and game mechanics for serious games analysis. *British Journal of Educational Technology*, *46*(2), 391-411.

Balzer, M. (2011). Immersion as a prerequisite of the didactical potential of role-playing. *International Journal of Role-Playing*, *2*(1), 32-43.

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013). Improving participation and learning with gamification. In *Proceedings of the First International Conference on gameful design, research, and applications* (pp. 10-17).

Bartle, R.A. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research*, *1*(1), 19.

Berkling, K., Thomas, C. (2013). Gamification of a Software Engineering course and a detailed analysis of the factors that lead to it's failure. Interact. Collab. Learn. (ICL), 2013 Int. Conf. September, 525–530 (2013).

Blohm, I., & Leimeister, J. M. (2013). Design of IT-Based Enhancing Services for Motivational Support and Behavioral Change.

Bozkurt, A., & Durak, G. (2018). A systematic review of gamification research: In pursuit of homo ludens. *International Journal of Game-Based Learning (IJGBL)*, *8*(3), 15-33.

Brewer, R., Anthony, L., Brown, Q., Irwin, G., Nias, J., & Tate, B. (2013). Using gamification to motivate children to complete empirical studies in lab environments. In Proceedings of the 12th international conference on interaction design and children (pp. 388-391).

Bunchball, I. (2010). Gamification 101: An introduction to the use of game dynamics to influence behavior. White paper, 9.

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & education*, *59*(2), 661-686.

Costello, B., & Edmonds, E. (2007). A study in play, pleasure and interaction design. In Proceedings of the 2007 conference on Designing pleasurable products and interfaces (pp. 76-91).

Crooltall, D., Oxford, R., & Saunders, D. (1987). Towards a reconceptualization of simulation: From representation to reality. *Simulation/games for learning*, *17*(4), 147-71.

Curtis, J. R., Wenrich, M. D., Carline, J. D., Shannon, S. E., Ambrozy, D. M., & Ramsey, P. G. (2001). Understanding physicians' skills at providing end-of-life care: perspectives of patients, families, and health care workers. Journal of general internal medicine, 16(1), 41-49.

Dahl, G., & Kraus, M. (2015). Measuring how game feel is influenced by the player avatar's acceleration and deceleration: using a 2D platformer to describe players' perception of controls in videogames. In Proceedings of the 19th International Academic Mindtrek Conference (pp. 41-46).

Deci, E., Koestner, R., and Ryan, R. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. Psychological bulletin 125, 6, 627–668.

Deci, E. L., Koestner, R., & Ryan, R. M. (2001). Extrinsic Rewards and Intrinsic Motivation in Education: Reconsidered Once Again. Review of Educational Research, 71(1), 1–27.

Deci, E. L., & Ryan, R. M. (2002). Overview of self-determination theory: An organismic dialectical perspective. Handbook of self-determination research, 3-33.

Denny, P. (2013). The effect of virtual achievements on student engagement. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 763-772).

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: defining gamification. In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15). ACM.

Deterding, S. (2014). The ambiguity of games: Histories and discourses of a gameful world.

Deterding, S. (2015). The lens of intrinsic skill atoms: A method for gameful design. Human–Computer Interaction, 30(3-4), 294-335.

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Journal of Educational Technology & Society*, *18*(3).

Dicheva, D., & Dichev, C. (2015). Gamification in Education: Where are we in 2015?. In E-Learn: World conference on E-learning in corporate, government, healthcare, and higher education (pp. 1445-1454). Association for the Advancement of Computing in Education (AACE).

Dichev, C., Dicheva, D., Angelova, G., & Agre, G. (2015). From gamification to gameful design and gameful experience in learning. Cybernetics and Information Technologies, 14(4), 80-100.

Domínguez, A., Saenz-De-Navarrete, J., De-Marcos, L., FernáNdez-Sanz, L., PagéS, C., & MartíNez-HerráIz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. Computers & education, 63, 380-392.

Draper, S. W. (1999). Analysing fun as a candidate software requirement. *Personal Technologies*, *3*(3), 117-122.

Duchenaut, N. and R. J. Moore. (2005). "More than just 'XP': Learning social skills in massively multiplayer online games," in Interactive Technology & Smart Education vol. 2 (2005): 89-100.

Dweck, C. S. (1986). Motivational processes affecting learning. American psychologist, 41(10), 1040.

Eleftheria, C. A., Charikleia, P., Iason, C. G., Athanasios, T., & Dimitrios, T. (2013). An innovative augmented reality educational platform using Gamification to enhance lifelong learning and cultural education. In IISA 2013 (pp. 1-5). IEEE.

Ferguson, W., Bareiss, R., Birnbaum, L., & Osgood, R. (1992). ASK systems: An approach to the realization of story-based teachers. *The Journal of the Learning Sciences*, *2*(1), 95-134.

Fontijn, W., & Hoonhout, J. (2007). Functional fun with tangible user interfaces. In 2007 First IEEE International Workshop on Digital Game and Intelligent Toy Enhanced Learning (DIGITEL'07) (pp. 119-123). IEEE.

Gay, V., Leijdekkers, P., & Pooley, A. (2016). Building social awareness for teens and young adults with autism via gamification. In Joint International Conference on Serious Games (pp. 116-127). Springer, Cham.

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment (CIE)*, *1*(1), 20-20.

Gerling, K. M., Birk, M., Mandryk, R. L., & Doucette, A. (2013). The effects of graphical fidelity on player experience. In *Proceedings of international conference on Making Sense of Converging Media* (pp. 229-236).

Glenberg, A. M., & Robertson, D. A. (1999). Indexical understanding of instructions. *Discourse processes*, *28*(1), 1-26.

Goehle, G. (2013). Gamification and Web-based Homework. Primus: Problems, Resources, and Issues in Mathematics Undergraduate Studies, 23(3), 234.

González Sánchez, J. L. (2010). Jugabilidad: Caracterización De La Experiencia Del Jugador En Videojuegos.

Griffiths, M. D. (2002). The educational benefits of videogames. *Education and health*, *20*(3), 47-51.

Haaranen, L., Ihantola, P., Hakulinen, L., & Korhonen, A. (2014). How (not) to introduce badges to online exercises. In *Proceedings of the 45th ACM technical symposium on Computer science education* (pp. 33-38).

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does Gamification Work? – A Literature Review of Empirical Studies on Gamification. In proceedings of the 47th Hawaii International Conference on System Sciences, Hawaii, USA, January 6-9, 2014.

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2016). Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. Computers in human behavior, 54, 170-179.

Hannula, O., & Harviainen, J. T. (2016). Efficiently inefficient: Service design games as innovation tools. In *Service Design Geographies. Proceedings of the ServDes. 2016 Conference* (No. 125, pp. 241-252). Linköping University Electronic Press.

Harviainen, J. T., & Lieberoth, A. (2012). Similarity of social information processes in games and rituals: Magical interfaces. *Simulation & Gaming*, *43*(4), 528-549.

Harviainen, J. T., & Savonsaari, R. (2013). Larps in high schools. *New traditional games for learning*, 134-145.

Harviainen, J. T., Lainema, T., & Saarinen, E. (2014). Player-reported impediments to game-based learning. Transactions of the Digital Games Research Association, 1(2).

Harviainen, J. T., & Meriläinen, M. (2019). Educational Gamification: Challenges to Overcome and to Enjoy. In Neo-Simulation and Gaming Toward Active Learning (pp. 553-560). Springer, Singapore.

Hassenzahl, M., Schöbel, M., Trautmann, T. (2008). How motivational orientation influences the evaluation and choice of hedonic and pragmatic interactive products: The role of regulatory focus, Interacting with Computers, 20(4-5), 473-479

Hassenzahl, M., Diefenbach, S., & Göritz, A. (2010). Needs, affect, and interactive products–Facets of user experience. Interacting with computers, 22(5), 353-362.

Hassenzahl, M. (2010). Experience design: Technology for all the right reasons. *Synthesis lectures on human-centered informatics*, *3*(1), 1-95.

Hassenzahl, M., Eckoldt, K., Diefenbach, S., Laschke, M., Len, E., & Kim, J. (2013). Designing moments of meaning and pleasure. Experience design and happiness. International Journal of Design, 7(3).

Hicks, K., Dickinson, P., Holopainen, J., & Gerling, K. (2018). Good Game Feel: An Empirically Grounded Framework for Juicy Design.

Hong, S. G. (2014). Role of Housing System in MMORPG (Multi Massive Online Role Playing Game). *International Journal of Multimedia and Ubiquitous Engineering*, *9*(11), 53-60.

Houser, R., & DeLoach, S. (1998). Learning from games: Seven principles of effective design. *Technical Communication*, *45*(3), 319.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. Qualitative health research, 15(9), 1277-1288.

Huang, W. H. Y., & Soman, D. (2013). Gamification of education. *Research Report Series: Behavioural Economics in Action, Rotman School of Management, University of Toronto*.

Hung, A. C. Y. (2017). A critique and defense of gamification. Journal of Interactive Online Learning, 15(1).

Hunicke, R., LeBlanc, M., & Zubek, R. (2004). MDA: A formal approach to game design and game research. In Proceedings of the AAAI Workshop on Challenges in Game AI (Vol. 4, No. 1, p. 1722).

Huotari, K., & Hamari, J. (2017). A definition for gamification: anchoring gamification in the service marketing literature. *Electronic Markets*, *27*(1), 21-31.

Iosup, A., & Epema, D. (2014). An experience report on using gamification in technical higher education. In Proceedings of the 45th ACM technical symposium on Computer science education (pp. 27-32).

Jenkins, H. (2005). Getting into the game. *Educational Leadership*, *62*(7), 48-51.

Jonassen, D. H., & Hernandez-Serrano, J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. *Educational Technology Research and Development*, *50*(2), 65-77.

Kangas, M. (2010). Creative and playful learning: Learning through game co-creation and games in a playful learning environment. Thinking skills and Creativity, 5(1), 1-15.

Khaled, R. (2018). Questions over answers: Reflective game design. In Playful disruption of digital media (pp. 3-27). Springer, Singapore.

Kifetew, F. M., Munante, D., Perini, A., Susi, A., Siena, A., Busetta, P., & Valerio, D. (2017). Gamifying collaborative prioritization: Does pointsification work?. In 2017 IEEE 25th International Requirements Engineering Conference (RE) (pp. 322-331). IEEE.

Kim, S., Choi, D., Lee, E., & Rhee, W. (2017). Churn prediction of mobile and online casual games using play log data. PloS one, 12(7), e0180735.

Kiryakova, G., Angelova, N., & Yordanova, L. (2014). Gamification in education. Proceedings of 9th International Balkan Education and Science Conference.

Klock, A. C. T., Da Cunha, L. F., de Carvalho, M. F., Rosa, B. E., Anton, A. J., & Gasparini, I. (2015). Gamification in e-learning systems: A conceptual model to engage students and its application in an adaptive e-learning system. In *International Conference on Learning and Collaboration Technologies* (pp. 595-607). Springer, Cham.

Klopfer, E., Osterweil, S., & Salen, K. (2009). *Moving learning games forward*. Cambridge, Massachusetts: The Education Arcade.

Koivisto, J., & Hamari, J. (2014). Demographic differences in perceived benefits from gamification. Computers in Human Behavior, 35, 179-188.

Korhonen, H., Montola, M., & Arrasvuori, J. (2009). Understanding playful user experience through digital games. In International Conference on Designing Pleasurable Products and Interfaces (Vol. 2009).

Krause, M., Mogalle, M., Pohl, H., & Williams, J. J. (2015). A playful game changer: Fostering student retention in online education with social gamification. In Proceedings of the Second (2015) ACM conference on Learning@ Scale (pp. 95-102).

Lallemand, C., Koenig, V., & Gronier, G. (2014). How relevant is an expert evaluation of user experience based on a psychological needs-driven approach?. In Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational (pp. 11-20). ACM.

Lee, E. (2005). The relationship of motivation and flow experience to academic procrastination in university students. *The Journal of Genetic Psychology*, *166*(1), 5-15.

Lee, J. J., & Hammer, J. (2011). Gamification in Education: What, How, Why Bother?. Academic Exchange Quarterly, 15(2), 146.

Lee, H., Doh, Y.Y. (2012). A study on the relationship between educational achievement and emotional engagement in a gameful interface for video lecture systems. In: Proceedings of the 2012 International Symposium on Ubiquitous Virtual Reality. Presented at ISUVR 2012. IEEE, pp. 34–37.

Lewis, C., Wardrip-Fruin, N., & Whitehead, J. (2012). Motivational game design patterns of'ville games. In Proceedings of the International Conference on the Foundations of Digital Games (pp. 172-179). ACM.

Li, W., Grossman, T., & Fitzmaurice, G. (2012). GamiCAD: a gamified tutorial system for first time autocad users. In Proceedings of the 25th annual ACM symposium on User interface software and technology (pp. 103-112).

Lim, T., Louchart, S., Suttie, N., Ritchie, J. M., Aylett, R. S., Stanescu, I. A., ... & Moreno-Ger, P. (2013). Strategies for effective digital games development and implementation. In *Cases on digital game-based learning: Methods, models, and strategies* (pp. 168-198). IGI Global.

Lucardie, D. (2014). The impact of fun and enjoyment on adult's learning. Procedia-Social and Behavioral Sciences, 142, 439-446.

Lucero, A., & Arrasvuori, J. (2010). PLEX Cards: a source of inspiration when designing for playfulness. In Proceedings of the 3rd International Conference on Fun and Games (pp. 28-37). ACM.

Lucero, A., Holopainen, J., Ollila, E., Suomela, R., & Karapanos, E. (2013). The playful experiences (PLEX) framework as a guide for expert evaluation. In Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces (pp. 221-230). ACM.

Marcotte, J. (2018). Queering Control (lers) Through Reflective Game Design Practices. Game Studies, 18(3).

Malone, T. W. (1982). Heuristics for designing enjoyable user interfaces: Lessons from computer games. In Proceedings of the 1982 conference on Human factors in computing systems (pp. 63-68).

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological review*, *98*(2), 224.

McDaniel, R., Lindgren, R., & Friskics, J. (2012). Using badges for shaping interactions in online learning environments. In 2012 IEEE international professional communication conference (pp. 1-4). IEEE.

Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013). Do points, levels and leaderboards harm intrinsic motivation? An empirical analysis of common gamification elements. In Proceedings of the First International Conference on gameful design, research, and applications (pp. 66-73).

Milošević, M., Živić, N., & Andjelković, I. (2017). Early churn prediction with personalized targeting in mobile social games. Expert Systems with Applications, 83, 326-332.

Mora, A., Riera, D., González, C., & Arnedo-Moreno, J. (2017). Gamification: a systematic review of design frameworks. *Journal of Computing in Higher Education*, *29*(3), 516-548

Morschheuser, B., Hamari, J., Werder, K., & Abe, J. (2017). How to gamify? A method for designing gamification. In *Proceedings of the 50th Hawaii International Conference on System Sciences 2017*. University of Hawai'i at Manoa

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International journal of qualitative methods*, *1*(2), 13-22.

Moseley, A. (2008). An alternative reality for higher education? Lessons to be learned from online reality games. In *ALT-C*.

Moshirnia, A. V., & Walker, A. C. (2007). Reciprocal Innovation in Modding Communities as a means of Increasing Cultural Diversity and Historical Accuracy in Video Games. In DiGRA Conference.

Mueller, F., & Isbister, K. (2014). Movement-based game guidelines. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2191-2200).

Mühlhaus, J., Frieg, H., Bilda, K., & Ritterfeld, U. (2017). Game-based speech rehabilitation for people with Parkinson's Disease. In International Conference on Universal Access in Human-Computer Interaction (pp. 76-85). Springer, Cham.

Nacke, L. E., Bateman, C., & Mandryk, R. L. (2011). BrainHex: preliminary results from a neurobiological gamer typology survey. In *International conference on entertainment computing* (pp. 288-293). Springer, Berlin, Heidelberg.

Nah, F. F. H., Telaprolu, V. R., Rallapalli, S., & Venkata, P. R. (2013). Gamification of education using computer games. In *International Conference on Human Interface and the Management of Information* (pp. 99-107). Springer, Berlin, Heidelberg.

Nah, F. F. H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P., & Eschenbrenner, B. (2014a). Gamification of education: a review of literature. In International conference on hci in business (pp. 401-409). Springer, Cham.

Nah, F. F. H., Eschenbrenner, B., Zeng, Q., Telaprolu, V. R., & Sepehr, S. (2014b). Flow in gaming: literature synthesis and framework development. *International Journal of Information Systems and Management*, *1*(1-2), 83-124.

Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. Psychological review, 91(3), 328.

Nicholson, S. (2012). A user-centered theoretical framework for meaningful gamification. *Games+ Learning+ Society*, *8*.

Nicholson, S. (2015). A recipe for meaningful gamification. In Gamification in education and business (pp. 1-20). Springer, Cham.

O'Donovan, S., Gain, J., & Marais, P. (2013). A case study in the gamification of a university-level games development course. In Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference (pp. 242-251).

Paulus, T. M., Horvitz, B., & Shi, M. (2006). 'Isn't it just like our situation?'Engagement and learning in an online story-based environment. *Educational Technology Research and Development*, *54*(4), 355-385.

Pechenkina, E., Laurence, D., Oates, G., Eldridge, D., & Hunter, D. (2017). Using a gamified mobile app to increase student engagement, retention and academic achievement. International Journal of Educational Technology in Higher Education, 14(1), 31.

Proulx, J. N., Romero, M., & Arnab, S. (2017). Learning mechanics and game mechanics under the perspective of self-determination theory to foster motivation in digital game based learning. Simulation & Gaming, 48(1), 81-97.

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of general psychology*, *14*(2), 154-166.

Robson, K., Plangger, K., Kietzmann, J. H., McCarthy, I., & Pitt, L. (2015). Is it all a game? Understanding the principles of gamification. *Business Horizons*, *58*(4), 411-420.

Rossiter, M. (2002). Narrative and Stories in Adult Teaching and Learning. ERIC Digest.

Ryan, R. M., & Deci, E. L. (2000a). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology*, *25*(1), 54-67.

Ryan, R. M., & Deci, E. L. (2000b). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American psychologist, 55(1), 68.

Sailer, M., Hense, J., Mandl, J., & Klevers, M. (2013). Psychological perspectives on motivation through gamification. Interaction Design and Architecture Journal, (19), 28-37.

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371-380.

Sakamoto, M., Nakajima, T., & Alexandrova, T. (2012). Value-based design for gamifying daily activities. In International Conference on Entertainment Computing (pp. 421-424). Springer, Berlin, Heidelberg.

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of human-computer studies*, *74*, 14-31.

Sezgin, S. (2020). Digital Player Typologies in Gamification and Game-Based Learning Approaches: A Meta-Synthesis. Bartin Üniversitesi Egitim Fakültesi Dergisi, 9(1), 49-68.

Sheldon, K. M., Elliot, A. J., Kim, Y., & Kasser, T. (2001). What is satisfying about satisfying events? Testing 10 candidate psychological needs. Journal of Personality and Social Psychology, 80(2), 325-339. doi:10.1037// O022-3514.80.2.325

Simpson, E. S. (2005). Evolution in the classroom: What teachers need to know about the video game generation. *2005 Annual Proceedings-Orlando: Volume# 2*, 477

Simões, J., Redondo, R. D., & Vilas, A. F. (2013). A social gamification framework for a K-6 learning platform. Computers in Human Behavior, 29(2), 345-353.

Solomon, J. (1987). *New thoughts on teacher education*. Oxford Review of Education, 13(3), 267-274.

Stircu, R. I. (2016). Forecasting Mobile Games' Retention using Weka. Database Systems Journal, 7(1), 22-27.

Sweetser, P., & Wyeth, P. (2005). GameFlow: a model for evaluating player enjoyment in games. Computers in Entertainment (CIE), 3(3), 3-3.

Taharim, N. F., Lokman, A. M., Isa, W. A. R. W. M., & Noor, N. L. M. (2013). A relationship model of playful interaction, interaction design, kansei engineering and mobile usability in mobile learning. In 2013 IEEE conference on open systems (ICOS) (pp. 22-26). IEEE. Taharim et al., 2013,

Taylor, G., Jungert, T., Mageau, G. A., Schattke, K., Dedic, H., Rosenfield, S., & Koestner, R. (2014). A self-determination theory approach to predicting school achievement over time: The unique role of intrinsic motivation. *Contemporary Educational Psychology*, *39*(4), 342-358.

Toda, A. M., Valle, P. H., & Isotani, S. (2017). The dark side of gamification: An overview of negative effects of gamification in education. In *Researcher Links Workshop: Higher Education for All* (pp. 143-156). Springer, Cham

Tyni, H., Sotamaa, O., & Toivonen, S. (2011). Howdy pardner!: on free-to-play, sociability and rhythm design in FrontierVille. In Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments (pp. 22-29). ACM.

Vanden Abeele, V., Wouters, J., Ghesquière, P., Goeleven, A., & Geurts, L. (2015). Game-based assessment of psycho-acoustic thresholds: Not all games are equal!. In Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play (pp. 331-341).

Viljanen, M., Airola, A., Majanoja, A. M., Heikkonen, J., & Pahikkala, T. (2017). Measuring player retention and monetization using the mean cumulative function. arXiv preprint arXiv:1709.06737.

Williams, P., Nesbitt, K., Eidels, A., & Elliott, D. (2011). Balancing risk and reward to develop an optimal hot-hand game. Game Studies, 11(1).

Wouters, P., Van Nimwegen, C., Van Oostendorp, H., & Van Der Spek, E. D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. Journal of educational psychology, 105(2), 249.

9.2. Online articles

Bhargava, V. (2018). Best Practices For Creating A Referral Program in Mobile Games. Retrieved from: https://medium.com/@VanhishikhaB/best-practices-for-creating-a-referral-program-in-mobile-games-f03de1a7d5d

Bogost, I. (2011). Gamification is Bullshit. Ian Bogost. Retrieved from http://bogost.com/writing/blog/gamification_is_bullshit/

Bowles, C. (2013). Looking Beyond User-Centered Design. Retrieved from: https://alistapart.com/column/looking-beyond-user-centered-design/

Columbia, n.d. Content Analysis. Retrieved from: https://www.mailman.columbia.edu/research/population-health-methods/content-analysis

Cruaud, C. (2018). The playful frame design and use of a gamified application for foreign language learning. (Doctoral dissertation, University of Oslo, Norway). Retrieved from: https://www.duo.uio.no/bitstream/handle/10852/60251/PhD-Caroline-Cruaud--2018.pdf?sequence=1

Dayan, Z. (2018). CodeMonkey Awarded Best Coding & Computational Thinking Solution. Retrieved from: https://www.codemonkey.com/blog/codemonkey-awarded-best-coding-computational-thinking-solution/

Edu.n.d, n.d. Retrieved from: https://edu.nd.com.hk/coding-galaxy/?lang=en

Elevateapp, n.d. Retrieved from: https://www.elevateapp.com/

Gabler, K., Gray, K., Shodhan, S., & Kucic, M. (2005). How to prototype a game in under 7 Days. Gamasutra. Retrieved from: https://www.gamasutra.com/view/feature/130848/how_to_prototype_a_game_in_under_7_.php

Gamasutra. (2006). The Importance of Risk in Basic Game Design. Retrieved from: https://www.gamasutra.com/view/feature/130243/the_importance_of_risk_in_basic_.php

Graham, J. (2014). Meet Apple's iPhone app of the year: Elevate. Retrieved from: https://eu.usatoday.com/story/tech/personal/2014/12/08/meet-apples-iphone-app-of-the-year--elevate/19951673/

Guyne, R.H. (2007). The Educational Benefits of Video Games. Retrieved from: https://www.techlearning.com/news/the-educational-benefits-of-video-games

Jonasson, M., & Purho, P. (2012). Juice it or lose it. In Game Developer's Conference. Retrieved from: https://www.youtube.com/watch?v=Fy0aCDmgnxg

Koivisto, J. (2017). Gamification: A study on users, benefits and literature. (Academic dissertation, University of Tampere, Finland). Retrieved from: https://trepo.tuni.fi/bitstream/handle/10024/102270/978-952-03-0550-5.pdf

Koster, R. (2019). What drives retention. Gamasutra. Retrieved from: https://www.gamasutra.com/blogs/RaphKoster/20190131/335683/What_Drives_Retention.php

Lovell, N. (2011). Retention rate, churn and duration. Retrieved from: https://www.gamesbrief.com/2011/11/retention-rate-churn-and-duration/

Mark, D. (2010). Rubber-Banding as a Design Requirement. Gamasutra. Retrieved from: https://www.gamasutra.com/blogs/DaveMark/20100602/87445/RubberBanding_as_a_Design_Requirement.php

Mathseeds, n.d. Retrieved from: https://mathseeds.co.uk/assets/mathseeds-schools-brochure.pdf

Matte, C. 2019. Papumba Academy. Retrieved from: https://www.commonsensemedia.org/app-reviews/papumba-academy

Robertson, M. (2010). Can't play, won't play. Retrieved from: http://hideandseek.net/2010/10/06/cant-play-wont-play/

Swink, S. (2007). Game feel: The secret ingredient. Gamasutra: Retrieved from: https://www.gamasutra.com/view/feature/130734/game_feel_the_secret_ingredient

Vahlo, J. (2018). In gameplay: the invariant structures and varieties of the video game gameplay experience. (Doctoral dissertation, University of Turku, Finland). Retrieved from: https://pdfs.semanticscholar.org/ef84/05d363dcd9e51c6810f130ebb8814b026ec3.pdf

Wehmeyer, M.L, Shogren, K.A & Toste, J. (2018). Self-Determination Theory. Retrieved from: https://www.oxfordbibliographies.com/view/document/obo-9780199828340/obo-9780199828340-0218.xml

Wikipedia, n.d. Cutscene. Retrieved from: https://en.wikipedia.org/wiki/Cutscene

WoWpediaa, n.d. Armor set. Retrieved from: https://wow.gamepedia.com/Armor_set

WoWpediab, n.d. Personal rating. Retrieved from: https://wow.gamepedia.com/Arena#Personal_rating

Zapzapmath, n.d. Retrieved from: https://www.zapzapmath.com/why-us/ecosystem

9.3. Bibliography

Alterio, M., & McDrury, J. (2003). *Learning through storytelling in higher education: Using reflection and experience to improve learning*. London, United Kingdom: Routledge.

Anderson, L. W. & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Harlow, United Kingdom: Longman.

Bartle, R. A. (2004). *Designing virtual worlds*. Indianapolis, Indiana: New Riders.

Benyon, D. (2010). *Designing interactive systems: A comprehensive guide to HCI, UX and interaction design* (2nd ed.). Pearson Education Canada.

Bjork, S., & Holopainen, J. (2005). *Patterns in game design*. Hingham, Massachusetts: Charles River Media.

Bogost, I. (2015). 2: Why Gamification is Bullshit. In Walz, S.P & Deterding, S. (2015). *The Gameful World: Approaches, Issues, Applications*. Cambridge, Massachusetts: MIT Press.

Brown, B., & Juhlin, O. (2015). *Enjoying machines*. Cambridge, Massachusetts: MIT Press.

Caillois, R. (2001). *Man, play, and games*. Champaign, Illinois: University of Illinois Press. (Original work published in 1961)

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. (4th edition). Los Angeles, California: Sage publications.

Csikszentmihalyi, M. (1975). *Beyond Boredom and Anxiety. The Experience of Play in Work and Games*. San Francisco, California: Jossey-Bass.

Csikszentmihalyi, M. (1990) *Flow: The Psychology of Optimal Experience*. New York, New York: Harper & Row.

Csikszentmihalyi, M. (1997) *Finding Flow: The Psychology of Engagement with Everyday Life*. New York, New York: Basic Books.

Csikszentmihalyi, M. (2014). *Applications of flow in human development and education*: *The Collected Works of Mihaly Csikszentmihalyi*. Dordrecht, Netherlands: Springer.

Dansky, R. (2007). Introduction to game narrative. In Bateman, C. M. (Ed.). (2007). *Game writing: Narrative skills for videogames*. Rockland, Massachusetts: Charles River Media.

Deci, E. L., & Ryan, R. M. (2004). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3-33). Rochester, New York: University of Rochester Press

Duhigg, C. (2012). *The power of habit: Why we do what we do in life and business*. New York, New York: Random House.

Eskola, J., & Suoranta, J. (1998). *Johdatus laadulliseen tutkimukseen*. Tampere, Finland: Vastapaino.

Fullerton, T., Swain, C., and Hoffman, S. (2004). *Game Design Workshop: Designing, Prototyping, and Playtesting Games*. San Francisco, California: CMP Books.

Gagné, R. M., L. J. Briggs and W. W. Wager. (1992). *Principles of instructional design*. Fort Worth, Texas: Harcourt Brace & Co.

Kapp, K. M. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education*. Hoboken, New Jersey: John Wiley & Sons.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. Upper Saddle River, New Jersey: Pearson.

Lankoski, P., & Björk, S. (2015). *Game research methods: An overview*. Pittsburgh, Pennsylvania: ETC Press.

Lieberoth, A., Wellnitz, K.B. & Aagaard, J. (2015). 11. Sex, violence and learning - Assessing game effects. In Lankoski, P., & Björk, S. (2015). *Game research methods: An overview*. Pittsburgh, Pennsylvania: ETC Press.

Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting & task performance*. Upper Saddle River, New Jersey: Prentice-Hall.

Luton, W. (2013). *Free-to-play: Making money from games you give away*. Indianapolis, Indiana: New Riders.

Malone, T. & Lepper, M. (1987). 10. Making Learning Fun: A Taxonomy of Intrinsic Motivations for Learning. In Snow, R., & Farr, M. (1987). *Conative and affective process analyses*. Hillsdale, New Jersey: L. Erlbaum.

Marczewski, A. (2013). *Gamification: a simple introduction*. Andrzej Marczewski.

McCarthy, J., & Wright, P. (2007). *Technology as experience*. Cambridge, Massachusetts: MIT press.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York, New York: Penguin.

Mezirow, J. (1990). *Fostering critical reflection in adulthood*. San Francisco, California: Jossey-Bass Publishers.

Norman, D.A. (2005). *Emotional Design: Why We Love (or Hate) Everyday Things*. New York, New York: Basic Books.

Piaget, J. (1985). *The equilibration of cognitive structures: The central problem of intellectual development*. Chicago, Illinois: University of Chicago Press.

Read, J. L., & Reeves, B. (2009). *Total engagement: using games and virtual worlds to change the way people work and businesses compete*. Brighton, Massachusetts: Harvard Business Press.

Rhett, L. & Apperley, T. (2019). Eurocentric Values at Play - Modding the Colonial from the Indigenous Perspective in Penix-Tadsen, P. (2019). *Video Games and the Global South*. Pittsburgh, Pennsylvania: ETC Press.

Salen, K. & Zimmerman, E. (2004). *24: Games as the Play of Pleasure.* In *Rules of play: Game design fundamentals*. Cambridge, Massachusetts: MIT press.

Salo, U. M. (2015). Simsalabim, sisällönanalyysi ja koodaamisen haasteet. In *Umpikujasta oivallukseen: Refleksiivisyys empiirisessä tutkimuksessa*. Tampere, Finland: Tampere University Press.

Schell, J. (2008). The Art of Game Design: A book of lenses. Burlington, Massachusetts: Morgan Kauffman.

Schön, D. A. (1984). *The reflective practitioner: How professionals think in action*. New York, New York: Basic books.

Seufert, E. B. (2013). *Freemium economics: Leveraging analytics and user segmentation to drive revenue*. Waltham, Massachusetts: Elsevier.

Swink, S. (2008). *Game feel: a game designer's guide to virtual sensation*. CRC Press.

Werbach, K., & Hunter, D. (2012). *For the Win: How game thinking can revolutionize your business*. Philadelphia, Pennsylvania: Wharton Digital Press.

Werbach, K., & Hunter, D. (2015). *The gamification toolkit - dynamics, mechanics, and components for the win*. Philadelphia, Pennsylvania: Wharton Digital Press.

Whitton, N. (2009). Learning with digital games: A practical guide to engaging students in higher education. London, United Kingdom: Routledge.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, California: O'Reilly Media.

9.4. Ludography

Alexey, P. (1984). *Tetris* [Video Game]. Multiple publishers.

Barr, P. (2013). *Art Game* [Video Game]. Pippinbarr.com

Blizzard Entertainment. (2004). *World of Warcraft* [Video Game]. Irvine, California: Blizzard Entertainment.

Blizzard North. (1997). *Diablo* [Video Game]. Irvine, California: Blizzard Entertainment.

Die Gute Fabrik. (2014). *Johann Sebastian Joust* [Video Game]. Copenhagen, Denmark: Die Gute Fabrik.

Epic Games. (2017). *Fortnite* [Video Game]. Cary, North Carolina: Epic Games

FromSoftware. (2011). *Dark Souls* [Video Game]. Tokyo, Japan: Bandai Namco Games

King. (2012). *Candy Crush Saga* [Video Game]. Stockholm, Sweden: King

Linden Lab. (2003). *Second Life* [Video Game]. San Francisco, California: Linden Lab.

Media Molecule. (2008). *LittleBigPlanet* [Video Game]. San Mateo, California: Sony Computer Entertainment

Mojang Studios. (2011). *Minecraft* [Video Game]. Stockholm, Sweden: Mojang Studios

Nintendo EAD. (1988). *Super Mario Bros. 3* [Video Game]. Kyoto, Japan: Nintendo.

Origin Systems. (1997). *Ultima Online* [Video Game]. San Francisco, California: Electronic Arts

Team Ico. (2001). *Ico* [Video Game]. Tokyo, Japan: SCE Japan Studio.

Valve. (1998). *Half-Life* [Video Game]. Los Angeles, California: Sierra Studios

Zynga. (2010). *FrontierVille* [Video Game]. Baltimore, Maryland: Zynga East.

ATTACHMENTS

Statement of commissioned research
August 2020

DESCRIPTION OF THE WORK

Education Alliance Finland (EAF) has commissioned Aleksi Kesseli to produce research to help the analysis of retention mechanics in educational solutions. In the beginning of the process the topic of the research was narrowed to gamified solutions, because it was expected that findings related to gamification could be applied to other solutions as well. The work was monitored by the EAF employee and the company suggested some relevant literature for the work.

VALIDATING THE FRAMEWORK

The first version of the framework was produced in December 2019 to be tested. The EAF expert evaluated two products with the framework and discussed the results with the product team. A corrected and expanded framework was used in three workshops led by an EAF expert during January - March 2020 . The workshops were held for educational companies working on digital products, and the aim was to help them reflect the pedagogical design, including the retention factors, of their products.

In the test and workshops, the findings on the framework were found valid and applicable to solutions that were matched with the framework. Some suggestion about adding new mechanics and altering some terminology was given after the test. However, it is acknowledged that a comprehensive and exhaustive list covering all possible mechanics was not possible to create and not in the scope of the work.

The final version of the framework was reviewed and accepted by EAF in July 2020. The framework was tested through design cases, where it proved to be a valuable tool for basing design decisions on theory of user behavior.

Education Alliance Finland

CONCLUSION

The work produced in this research was found theoretically solid and beneficial for EAF, and EAF will continue exploring the ways of applying the findings of this research. Publishing of the Master's theses accepted in Tampere University will conclude the commissioned work.

Date and signature

26.8.2020

_____

Olli Vallo, CEO